APPLIED Hydraulics & Pneumatics

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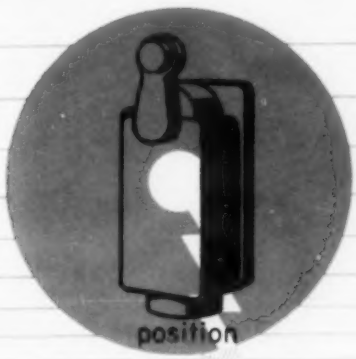

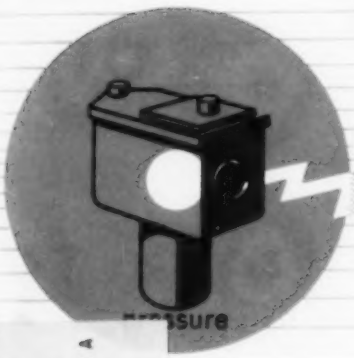

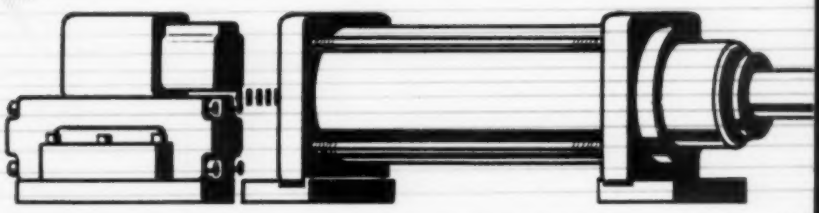

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Electrical Controls *for fluid power systems*

THE MAGAZINE OF FLUID POWER

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- Handles more air—with minimum pressure drop.
- Quick connection—and disconnection.
- Instant automatic flow or shut-off.
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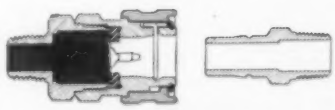

Socket, when disconnected, automatically shuts off air by leak-proof seal of metal valve against rubber valve seat.

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a ready reference when you want information on couplings in a hurry.

Quick-Connective Fluid Line Couplings for

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are used for controlling flow of petroleum liquids, water and synthetic hydraulic fluids.
Pressure to 1000 psi.
Sizes ¼", ⅜", ½" and ¾"
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To meet the demands for precision control of hydraulically powered equipment, Hanna offers this new calibrated speed control valve. Flow can be accurately regulated from zero to desired rate by turning the adjusting sleeve. Once set to the desired flow rate the valve can be "locked". Calibrations assist in setting the valve to pre-determined flow rates.

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Hanna Engineering Works

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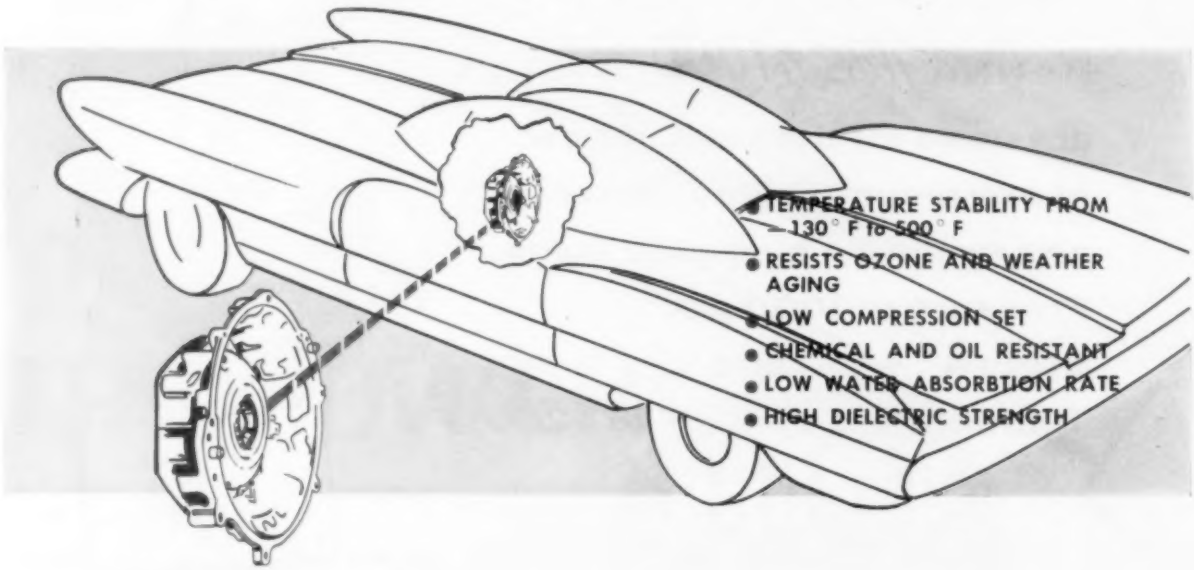
• TEMPERATURE STABILITY FROM —130° F to 500° F
• RESISTS OZONE AND WEATHER AGING
• LOW COMPRESSION SET
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Minnesota Rubber injection molded silicone parts enable designers to improve operating characteristics of scores of rubber components such as automatic transmission seals, bellows, diaphragms, electric insulators and molded parts subjected to unusually tough operating conditions.

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- **Temperature range** ..... —130 to 500° F
- **Tensile strength, psi** ..... 600 to 900
- **Tear strength, lb/in** ..... 40 to 75
- **Elongation, %** ..... 150 to 300
- **Compression set, % @ 300 F** ..... 15 to 40
- **Hardness range, durometer** ..... 20 to 90
- **Dielectric strength, volts/mil** ..... 400 to 500
- **Oil resistance, depending on oil** ..... good to excellent

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APPLIED
Hydraulics & Pneumatics

AUGUST 1959 VOLUME 12/NUMBER 8

THE MAGAZINE OF FLUID POWER

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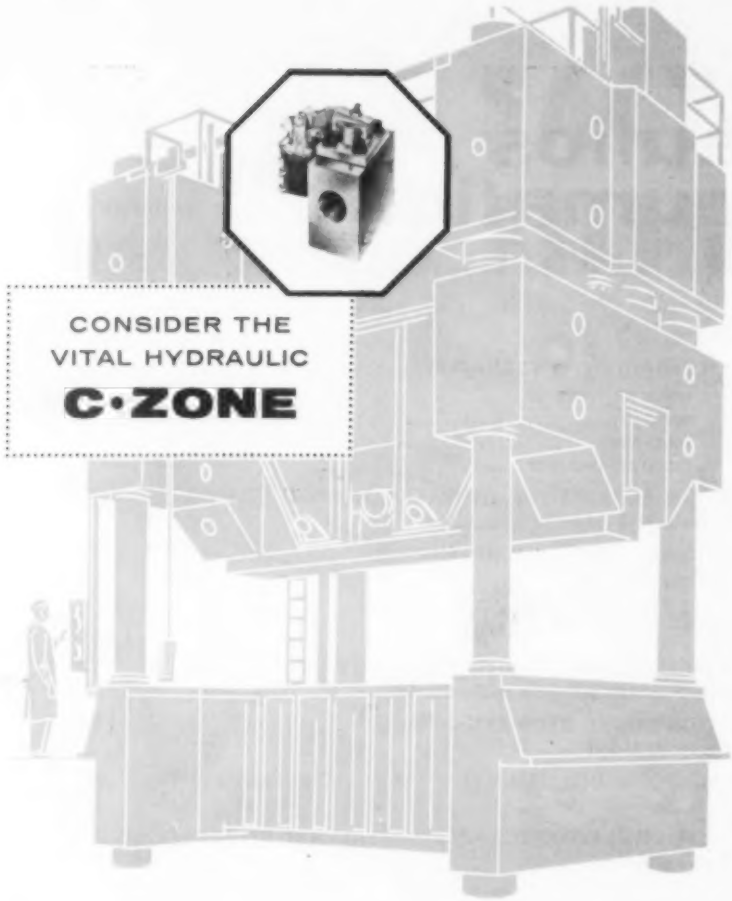

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Waterman representatives are in all principal cities. Write for Waterman Solenoid Valve Catalog No. 2000, and for Waterman Flow Regulator Catalog No. 1001.

W-5020

Also suppliers of AN and MS qualified flow regulators and fuses.

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NEW PRODUCTS

NEW ANCHOR HOSE FOR EXTRA HIGH PRESSURES

"Super-Spiral" Hose
Opens New Pressure Ranges
For Hydraulic Equipment

Hydraulic engineers attempting to design equipment utilizing higher operating pressures, have been defeated by absence of hose capable of handling these higher pressures. Recognizing the need, Anchor has just introduced a new spiral wound wire reinforced hose designed for use with substantially higher pressures.

ANCHOR SUPER-SPIRAL High Pressure Hose is available in both 4-ply and 6-ply spiral wound wire reinforced styles and in sizes from 3/16" I.D. to 1½" I.D. A 2" I.D. size is now under development for early availability. Maximum working pressures of the new 6-ply hose range from 12,500 psi for 3/16" I.D. to 3000 psi for 1½" I.D., and for the 4-ply, from 10,000 psi 3/16" I.D. to 2,500 psi 1½" I.D.

By the substitution of spirally wound wire reinforcement for the conventional wire braid, heavier wire (.022") can be used and the wire fatigue, caused by the crossed wires of the braid, is eliminated. This makes a stronger hose capable of handling much higher pressures without excessive increase in bulk and rigidity.

SUPER-SPIRAL Hose has an oil resistant neoprene inner tube and an oil, weather and abrasion resistant synthetic rubber cover with friction layers between each spiral wire reinforcement. It is available in assemblies fitted with Anchor Pressed-On Couplings.

See us at SAE Show, Milwaukee, September. Booth No. 156.

A supplement to Catalog 101 describes the new SUPER-SPIRAL High Pressure Hose and may be obtained from Anchor Coupling Co. Inc., 328 No. Fourth St., Libertyville, Ill.

Circle **10** *on Time-Saver Card*

ENGINEERED
to serve you better — longer!

ANCHOR®

Hose Assemblies, Couplings and Fittings!

The failure of a coupling or hose connection in a hydraulic line, with the ensuing delay, loss of time or production, can cost many times more than the coupling itself.

That is why such stringent quality standards, in both materials and workmanship, prevail at Anchor. Frequent inspections and tests are made in production to enforce these standards to the point where they are accepted Anchor factory practice.

Whatever your purchase from Anchor, hose assemblies, couplings, or fittings, they must conform to these high standards. Because of this, Anchor products have a reputation for quality and for trouble-free performance in the field.

When you specify Anchor for your hydraulic hose components and equipment you are selecting the line that is unsurpassed for dependability, long service and efficiency. Don't gamble with costly breakdowns and delays—specify Anchor always!

ANCHOR
Bent Tube Assemblies

Made to suit your individual requirements and specifications.

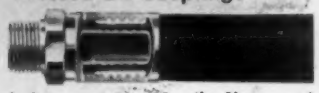
ANCHOR
Fittings, Adapters, Adapter Unions and SAE Boss "O"-Ring Fittings

90° Male Adapter Union — 45° "O"-Ring Straight-Thread Adapter — 45° Street Elbow

Andy Anchor says:
"The Anchor Products shown here represent only a small portion of the complete Anchor line."

WRITE FOR CONDENSED CATALOG No. 575

ANCHOR
Pressed On Couplings



For High Pressure-Anchor Ductile Sleeve and Sleeveless Couplings for 2, 3 and 4 Wire Braid and 6 ply Spiral Wire Wrap Hose, 3/16" to 2" I.D., 7000 P.S.I. to 750 P.S.I. Max. Work. Pres.

Medium and Low Pressure Assemblies

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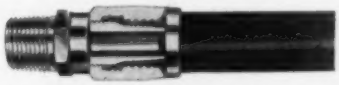
For "Hi-Burst" 2-Rayon Braid Hose, ¼" to 1¼" I.D., 1250 to 375 P.S.I. Max. Work. Pres.

ANCHOR
Reusable Couplings

For High and Medium Pressure



For Two Wire Braid Hose, ¼" to 1" I.D., from 5000 P.S.I. to 1875 P.S.I. Max. Work. Pres.

For One Wire Braid Hose, ¼" to ¾" I.D., from 2750 P.S.I. to 1250 P.S.I. Max. Work. Pres.

For Medium and Low Pressure

Anchor "Duloc" Couplings, for Style QW 1-Cotton, 1-Wire Braid, Cotton Braid Covered Hose with synthetic inner tube and Style QWR, same as QW but with thin rubber outer cover, 3/16" to 1 13/16" I.D., 3000 P.S.I. to 350 P.S.I. Max. Work. Pres.

For Medium and Low Pressure

For "Hi-Burst" 2 Rayon Braid Hose, ¼" to ¾" I.D., 1250 P.S.I. to 750 P.S.I. Max. Work. Pres.

For High, Medium and Low Pressure

Anchor Clamp Type Couplings for 2 Wire and 3 Wire Braid High Pressure Hose from ¼" to 2" I.D. and 5000 to 750 P.S.I. Max. Work. Pres. and 1 Wire Braid Medium Pressure Hose, ¼" to 2" I.D., from 2750 P.S.I. to 375 P.S.I. Max. Work. Pres. Also for Spiral Wire Suction Hose, ¾" to 2" I.D., 300 P.S.I. to 100 P.S.I. Max. Work. Pres. and "Hi-Burst" 2-Rayon Braid Hose, ½" to 1" I.D., 1000 P.S.I. to 550 P.S.I. Max. Work. Pres.

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Branch Offices—Dallas, Texas—Plymouth, Michigan

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NEW...
from Skinner!

3-way, high-flow, solenoid valves for general industrial use

Main orifice sizes: full effective—⅜", ½", ¾" for ⅜", ½", ¾" NPT.

Standard operating pressures: 5 to 150 psi.

Media: oil, air, water, vegetable and petroleum oils, inert gases, kerosene, gasoline.

Types: normally open, normally closed and directional control in standard and explosion-proof construction.

These new, 3-way L3 Series valves, like all Skinner valves, are built to UL standards. Their bodies are made of forged naval brass and their internal parts are stainless steel and brass. Soft, synthetic inserts and seals provide bubbletight sealing. And a unique, Buna-N coated nylon diaphragm assembly assures long life. The valves are compact, light, and mount in any position, directly to the line. They are offered in a wide range of voltages and frequencies, with many electrical options and manual override.

Typical applications: air vises, chemical process equipment, presses, water treatment equipment, industrial machinery, packaging machinery, air and hydraulic cylinders, laundry machinery, etc.

Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 318.

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY **THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT**

. . . Fluid Power news

REPORT NO. 12,105 NEW SECTION AND DRIVE IMPROVES PRODUCT

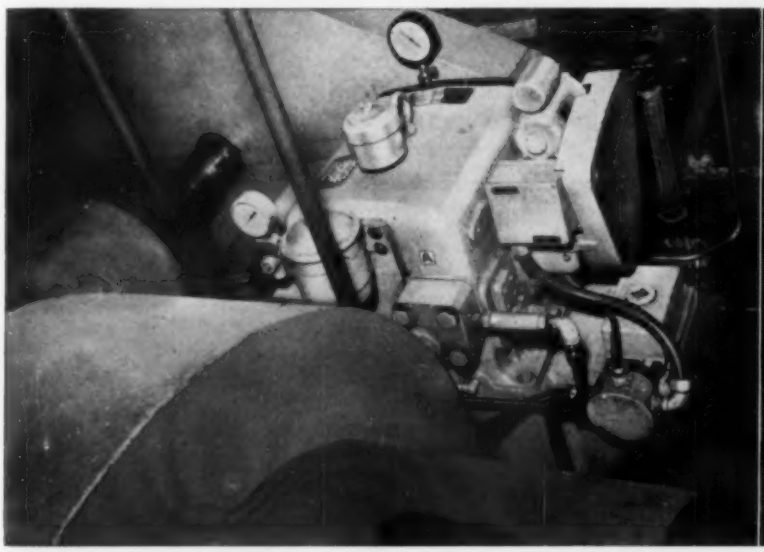
From Oilgear Application-Engineering Files

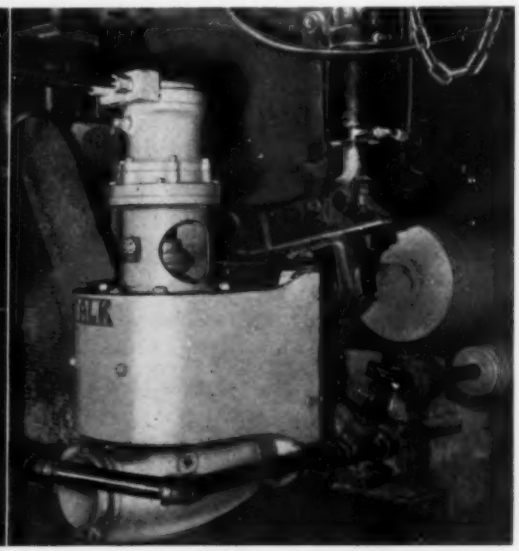
HOW OILGEAR HELPED SOLVE DRIVE PROBLEM FOR A NEW PAPER MACHINE SECTION

CUSTOMER: *A Large Midwestern Paper Manufacturer.*

DATA: To improve the finished surface of certain types and grades of paper, this manufacturer decided to insert a new sizing and smoothing section between existing sections of one of their paper machines. *Requirements: 1.* New section drive rpm must remain in same preset speed ratio with first dryer section roll regardless of over-all machine speed; allow precise, minutely controlled variation to increase or decrease wet sheet tension; hold constant speed within 6% regardless of increase or decrease of section roll pressures. *2.* Section drive to be inoperative at will without use of clutches . . . machine to operate with, or without the new section for dual purpose processing. *3.* Drive must be smooth, positive . . . without lag, shocks, or surges. *4.* Drive must fit within extremely limited, available space, and be direct-connected to new section sizing roll. *5.* Complete, individual control from a convenient, remote, push button station. *6.* Dependability, with a minimum of installation, or maintenance "downtime."

Note: A mechanical drive was considered, but space and control requirements would involve costly, major rebuilding of the entire machine.

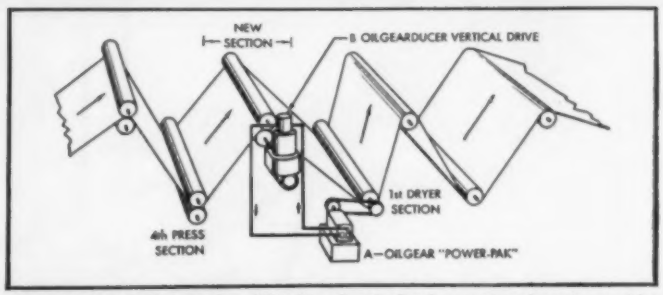




SOLUTION: Oilgear *Application-Engineers*, working in cooperation with company engineers, analyzed the speed, torque, control, and space limitations of this installation; and recommended an Oilgear "*Any-Speed*" drive consisting of a separate, heavy-duty, Oilgear pump and motor for the following reasons. *1.* An Oilgear Type "DE," Variable Displacement Pump with Electric Remote Control and Reservoir fitted into the very limited space available, and could easily be driven from the first dryer roll. *2.* A standard *Oilgearducer*—an Oilgear Constant Displacement Fluid Power Motor with integral right-angle gear reducer—could be direct-connected to the new section sizing roll. *3.* A simple pushbutton station for controlling this new section could be conveniently mounted on the opposite side of the paper machine. *Actual operation has proved that all initial requirements were either met or exceeded.*

Being a positive displacement drive, the direct-connected sizing roll rpm remains in the same speed ratio with the first dryer roll regardless of over-all machine speed. Original constant speed requirement—within 6%—is exceeded in actual operation . . . speed remains stable within 0.5% max. variation under full min. to max. load change. Two remote control station pushbuttons command the electric pilot control motor to increase or decrease pump displacement, changing the hydraulic motor speed and the section to machine ratio . . . precisely varying tension on the wet sheet. Section can be independently started and stopped from this station while the paper machine is running. Exact drive load and temperature are indicated. *In over four years of continuous, high-speed service, there has been no reported maintenance on this drive.*

This paper manufacturer has also Oilgear-equipped a laminator winder drive; the center winder on a super-calender stack; the unwind and rewind drives on another super-calender; five "wet-end" drives of another paper machine;



Oilgear Variable Displacement Pump (A) is driven from the first dryer section to keep the new sizing and smoothing press section speed in direct relation to the dryer section speed. Actual installation is shown in photo above, left. The small, geared-head pump control motor which changes pump stroke can be seen to the right of the pump. Controlled Fluid Power from the pump drives vertically mounted Oilgearducer (B), direct-connected to the sizing roll of the new section . . . as shown in photo above.

plus other applications in the mill and powerhouse. This user, like many others in all phases of all industry, knows that *for the lowest cost per year—it's Oilgear!* Additional drive application data is available—Bulletins 10600, 10051-G, and "News" 3, 5, 8—on request, without obligation.

For similar practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY

Application-Engineered Controlled Motion Systems

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FLUID POWER LINES

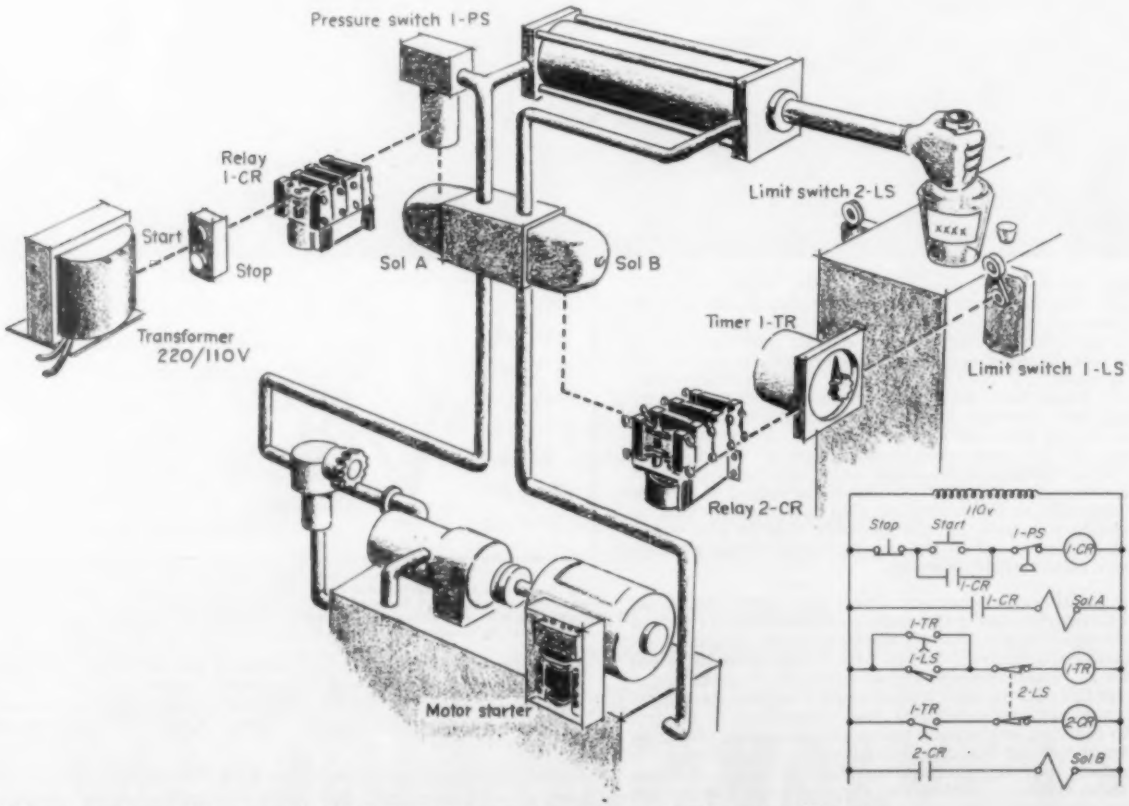
about hydraulics & pneumatics

DO-IT-YOURSELF BAR TENDER* . . . To illustrate how closely electrical and hydraulic systems work together, here's a design for a do-it-yourself bar tender. Outstanding feature: it outsmarts the tipplers who try to pour themselves a double for the price of a shot. This is how it works:

a. Press START button, actuate relay 1-CR and solenoid A. Cylinder extends.

b. With cylinder fully extended, pressure rises to relief valve setting. Pressure switch 1-PS actuates and de-energizes relay 1-CR and solenoid A. Limit switch 1-LS starts timer permitting customer to pour one drink.

c. When timer times out, it actuates relay 2-CR and solenoid B to retract cylinder. At full retraction, limit switch 2-LS trips to de-energize solenoid B, and reset timer.



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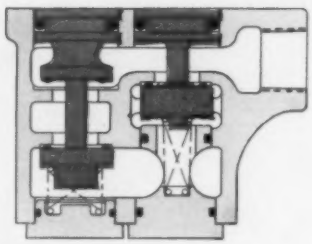
a basic Ross
valve building block

4-way inline mounted valve body



- **Compact—saves space**
- **Ross quality**
- **Costs much less than base mounted 4-way**

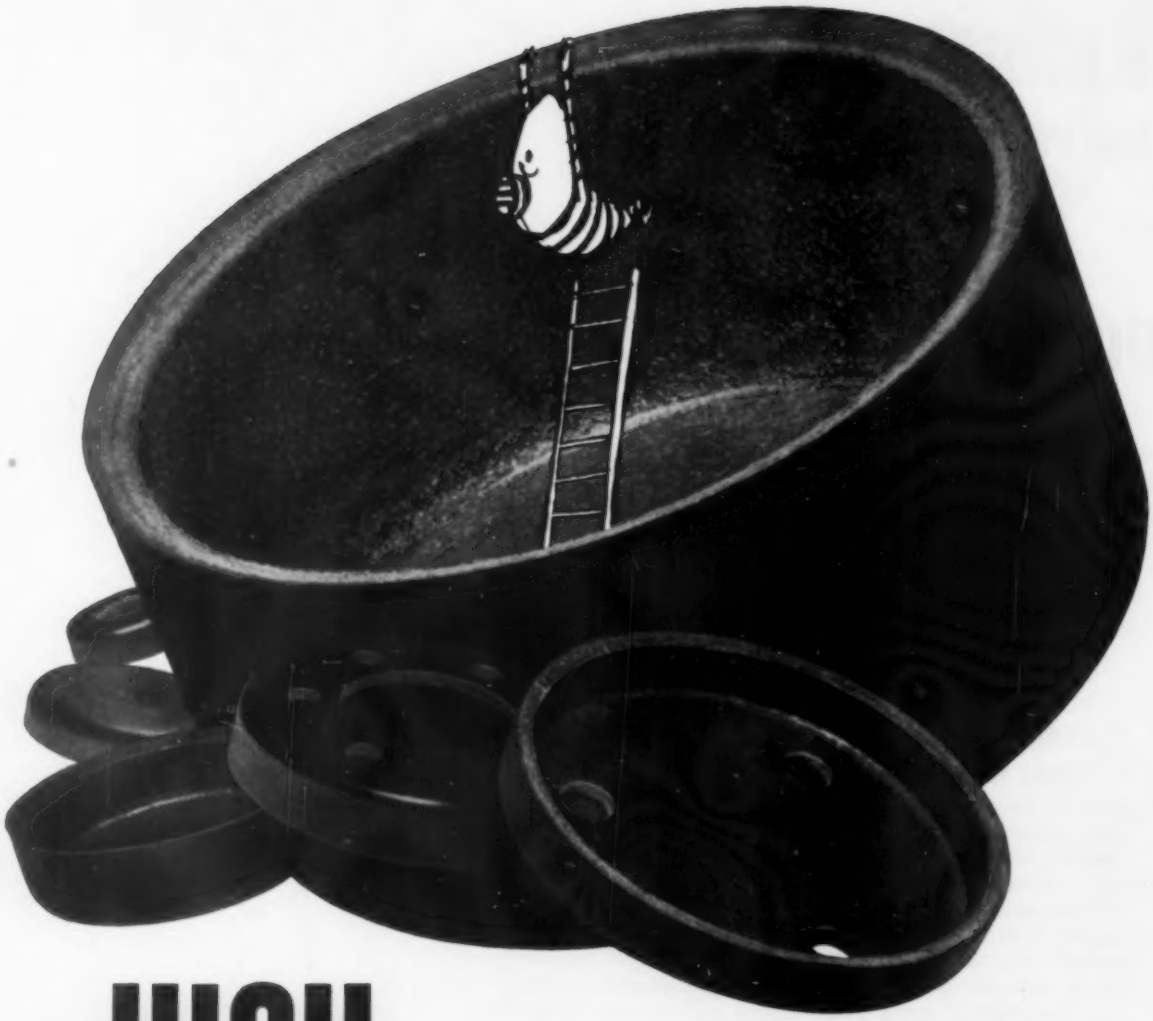
Lots of designers use this valve where they must save space. It was designed specifically for compactness! Others use it to save money *without sacrificing* quality—when J.I.C. allows the usage of an inline valve, it meets J.I.C. specs. It's a unit of the Ross Skyline series which features modular construction, so it can be actuated with any Skyline series head. Ross poppet construction means pressure assists the seal, and short poppet travel gives faster response. On most applications it outlives the machine—and frequently doesn't even require maintenance. Write for Bulletin 321.

* WHITEMODEL SPOOL SOLENOID
* GOLDMODEL OIL-IMMERSED SOLENOID
* SILVERMODEL JIC SPOOL SOLENOID
GREENMODEL DOUBLE SOLENOID MOMENTARY
BLUEMODEL AIR OPERATED
BLUEMODEL AIR-OPERATED MOMENTARY ADAPTOR
BLUEMODEL AIR-OPERATED TIMED IN
BLUEMODEL AIR-OPERATED TIMED-OUT
*THIS AIR INDEX ADAPTOR CONVERTS THESE HEADS TO MOMENTARY ACTION

"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES

Ross OPERATING VALVE COMPANY
105 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.



HIGH WALLED ?

How long since you have re-evaluated the wall height on your cup packings? Frequently IPC encounters "prints" which call for excessive wall height . . . *and* this extra depth can cause headaches.

Unnecessary wall height can only add to friction and make your cups run "hotter" . . . Torque increases . . . Toe-in is enhanced. Unless there is some unusual factor involved, IPC can recommend a more functional design without these built-in hazards.

Elaborate hide selection combined with IPC "custom treats" and IPC's square shouldered design mean your leather packings and oil seals are started "right". For the finishing touch, IPC offers the last word in quality controlled manufacture.

Let us analyze your leather packings. Perhaps we can tailor a design that will fit your application perfectly.

OIL SEALS
PACKINGS
PRECISION MOLDING
Custom designed
. . . for your application

IPC

INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

P5

DYNAMIC DIFFERENCE

in hydraulic performance

Webster

POSITIVE DISPLACEMENT GEAR-TYPE PUMPS

Things have changed on the golf course . . . the old converted Model A has been replaced by more efficient, specialty equipment. Like this Worthington mowing rig. It has front wheel drive, rear wheel steering and gang mowers that raise and lower hydraulically.

A fast-acting Webster hydraulic pump supplies a dependable flow of fluid power for this versatile application. For this same reason, Websters are used on all types of construction, maintenance, agricultural and industrial equipment. More, Webster Gear-Type Pumps are compact — adapt easily and economically to the job and your product.

Hydraulics in your design? Keep Webster in mind *for the dynamic difference that pays!*

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

our 50th year RACINE · WIS

HCS SERIES POSITIVE DISPLACEMENT GEAR-TYPE PUMP

Shaft seal: lip type
Drive: direct, gear or belt
Capacity: 5 sizes, 5 - 17 gpm
Pressure: to 1500 psi
Operating speeds: to 2400 rpm (1800 rpm max. on 4XCS)
Porting: side (Std.) end (Opt.)
Valve: optional; internal relief, adjustable 800 - 1500 psi

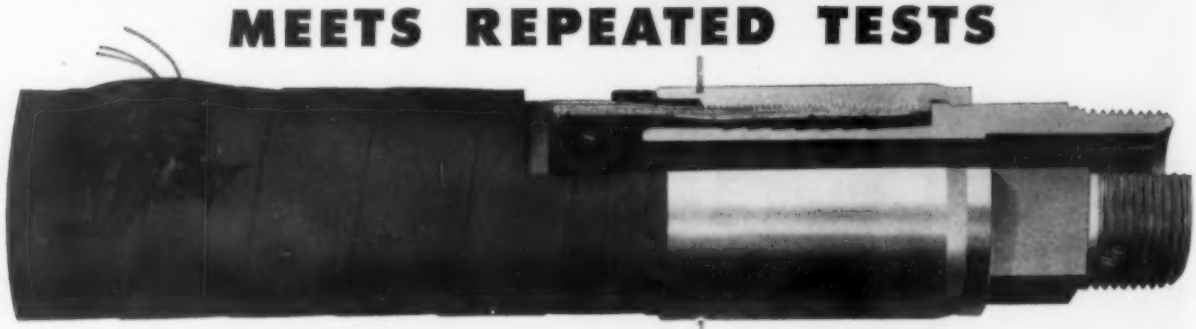
BULLETIN HY1 gives complete engineering characteristics — performance and installation data.

Call the man from Webster

. . . he's one of a staff of engineers specially trained in hydraulic application. He can help you solve special problems when hydraulics become a part of your design.

Photo from Worthington Mower Company, Stroudsburg, Pa., a subsidiary of Rockwell Manufacturing Co., Racine, Wis.

Eastman APPLICATION MEETS REPEATED TESTS



Tests prove that Eastman couplings applied to super high pressure 4-ply spiral wire hose assure successful assemblies. Couplings hold well above minimum burst pressure.

PERMANENTLY ATTACHED COUPLINGS PROVIDE BOND STRONGER THAN HOSE ITSELF!

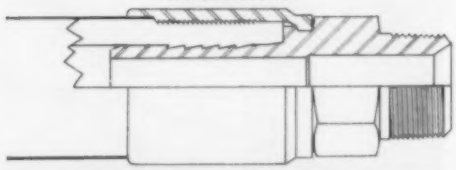
Increasing demand for greater power brought about the use of higher pressures in hydraulic systems. This not only calls for greater hose strength, but far more critical engineering in coupling design and application.

EASTMAN is contributing toward the development of the trend toward higher pressures—not only in the design and application of coupling to hose—but in the more exhaustive tests required to assure adequate safety under high pressure operations.

The actual photo above is typical of many tests in Eastman laboratories proving that the hose did not fail at the coupling—demonstrating that the coupling was designed and applied to form *a bond which was stronger than the hose itself.*

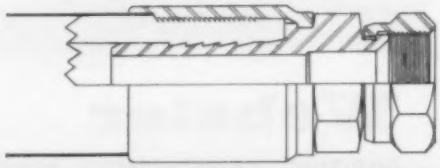
If you have an application requiring higher pressures, let our engineering department demonstrate the superiority and economy of Eastman applications, and quote on complete Hydraulic Hose Assemblies.

MALE NPTF



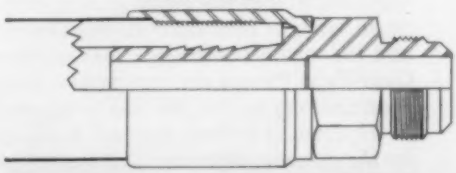
Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12M	3/4	1 7/16	19/32	20,000	5,000
8416-16M	1	1 3/4	25/32	16,000	4,000
8420-20M	1 1/4	2	1 5/64	12,000	3,000
8424-24M	1 1/2	2 1/4	1 21/64	10,000	2,500

SWIVEL FEMALE JIC-37°



Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12FH	3/4	1 7/16	19/32	20,000	5,000
8416-16FH	1	1 3/4	25/32	16,000	4,000
8420-20FH	1 1/4	2	1 5/64	12,000	3,000
8424-24FH	1 1/2	2 1/4	1 21/64	10,000	2,500

MALE JIC-37°



Catalog No.	Hose I.D.	Hose O.D.	Coupling I.D.	Min. Burst Pressure (P.S.I.)	Max. Wkg. Pressure (P.S.I.)
	(inches)				
8412-12MH	3/4	1 7/16	19/32	20,000	5,000
8416-16MH	1	1 3/4	25/32	16,000	4,000
8420-20MH	1 1/4	2	1 5/64	12,000	3,000
8424-24MH	1 1/2	2 1/4	1 21/64	10,000	2,500

Eastman
first in the field
MANUFACTURING COMPANY
Dept. AH-8
MANITOWOC, WISCONSIN

WRITE today for your copies—

Technical Bulletin 100—Medium Pressure Hose and Tube Assemblies, Couplings and Fittings for One Wire Braid Hose.

Technical Bulletin 200—High Pressure Hose and Tube Assemblies, Couplings and Fittings for Multiple Wire Braid Hose.

Circle **40** on Time-Saver Card

LETTERS
to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Adds information to fabricating report

TO THE EDITOR:

With reference to your June, 1959 report on the Fabricating Machinery Forum, there is another answer for those who desire 1" port solenoid valves in the Rivett 6000 series. This valve has been on the market and advertised in your pages since 1954 and does provide 1" capacity in the price range of other ¾" valves. Pressure drop curves on these valves are published in the Rivett catalog. Is it possible there is a typographical error in your figure on blocked port leakage flow? The leakage rate noted is considerably higher than those we have encountered.

W. G. PAUL, JR.
The Paul-Monroe Co.
Bell Gardens, Calif.

As far as we know, the blocked port leakage flow is as given at the Forum. Our experience is that this figure varies all over the lot and, of course, depends greatly upon the application and condition of the valve. If the leakage rates on your valves are considerably less, then it's just as you've always suspected, you sell a pretty good valve.

Magazine material requested for training course

TO THE EDITOR:

We are engaged in a training program on Industrial Hydraulics for our machine repair and pipefitter personnel. In reviewing back issues of your excellent publication, we have uncovered a wealth of material which we feel would be advantageously incorporated into our training program. I would like to obtain permission to reproduce drawing and test material which appears in your publication.

RICHARD J. KOSTER
The Budd Company
Detroit, Mich.

Continued on page 16

Choose Right...
Choose Pathon
4 Way Directional Control Valves

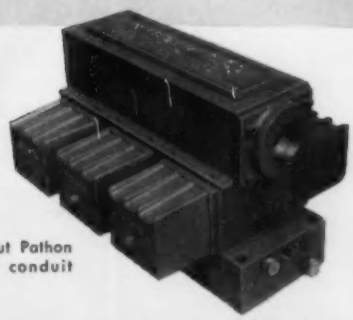
#2H4W1-S
¼" N.P.T. Ports
1¼ GPM
Direct Solenoid
2000 psi service

#2H4W3-S
⅜" N.P.T. Ports
8 GPM
Direct Solenoid
2000 psi service

#2H4W6-PS
¼" N.P.T. Ports
20 GPM
Pilot Operated
2000 psi service

They're
- Dependable
- Immediately Available
- Interchangeable with other good valves

Stock valves are equipped with 115 volt/50-60 cycle solenoids, however 230 volt/50-60 cycle, 460 volt/50-60 cycle, and others, are available on short notice. Both bottom plumbed and side plumbed subplate are available. Write for full information.



Inquire about Pathon valve and conduit manifolds.

Pathon MANUFACTURING COMPANY
C-59 3823 PACIFIC AVE. • CINCINNATI 12, OHIO
FLUID OPERATED AND CONTROL EQUIPMENT

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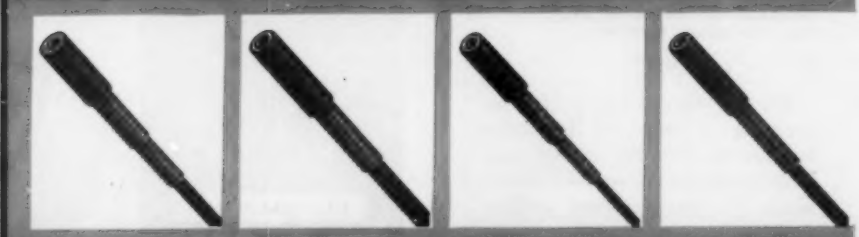
Scientific production
Offers
Scientific control

.....and that means the very best in Flexible Hoses. Our long experience, practical know-how and continuous laboratory research keep abreast of the growing needs of World Industry today. Hyline Flexible Hose — designated Low Pressure, Single Wire, Double Wire and Power Steering — is scientifically designed for use with gases or liquids at high or low pressures and temperatures.

Let the *scientifically produced* Hyline work for you.

Further information gladly supplied on request to Department H/1AH.



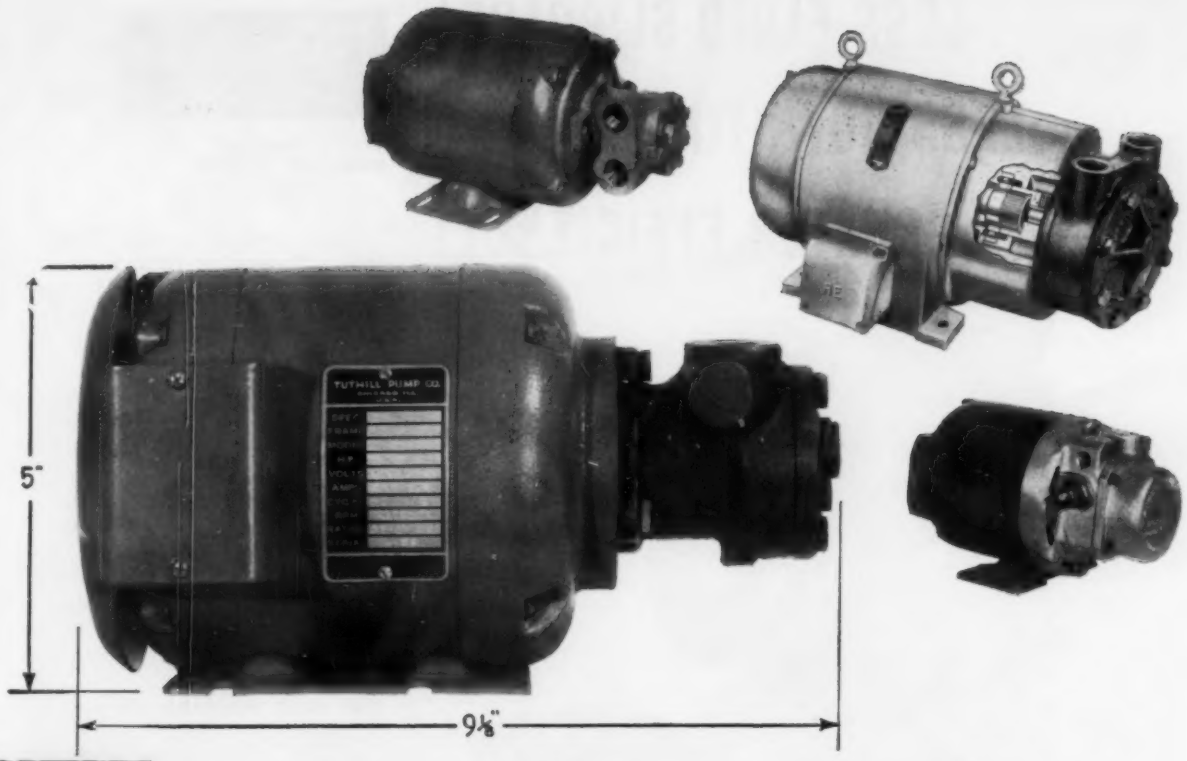
Hyline

F-L-E-X-I-B-L-E HOSE

SUPER OIL SEALS AND GASKETS LIMITED

FACTORY CENTRE — KINGS NORTON — BIRMINGHAM, 30, ENGLAND

Manufacturers of: Flexible Hose, Oil Seals and Hydraulic Packings, Precision Mouldings, Diaphragm Seals and Polythene Protective Caps and Plugs.



NEW pump & motor combination

adds to TUTHILL'S complete close-coupled line

The new Series 42 shown above further extends Tuthill's complete line of close coupled pump and motor units. These compact combinations have been especially developed to solve design problems and cut costs in hydraulic, oil burning, lubrication and a wide variety of other services.

As shown above, this compact new unit has overall measurements of only 9⅛" by 5". The totally enclosed motor is supplied with ratings of from 1/12 to 1/6 hp, while the pump units have a capacity of 1/3 to 3 gpm. The Series 42 may be supplied either with or without a built in relief valve.

Some other models in Tuthill's line of close coupled combinations are also shown above. These include a broad selection of units with capacities up to 50 gpm, for pressures to 500 psi.

Save space, weight and money

The compact design of these units solves tough design problems. The elimination of couplings, bases and adapters results in significant savings. The reduction of weight lowers shipping costs. And their compactness often simplifies assembly operations for further savings in production costs.

Available from stock

All the units shown above, plus many others are immediately available from stock. There is no minimum quantity requirement . . . so you can use these economical units in a wide variety of applications.

"POWERMITE" for OEM applications

For original equipment applications involving substantial production runs, Tuthill offers further savings in space and weight through the use of the POWERMITE. This is an exclusive Tuthill design in which pump and motor are incorporated into one unit, which takes up no more space and weighs no more than a conventional motor. For example, the Powermite shown at lower right above, measures only 8 1/6" by 4¾" . . . has a capacity of 16 gph at 350 psi.

Tuthill's engineers will be happy to develop a Powermite specifically designed for your OEM application . . . providing the greatest possible saving in space and weight.

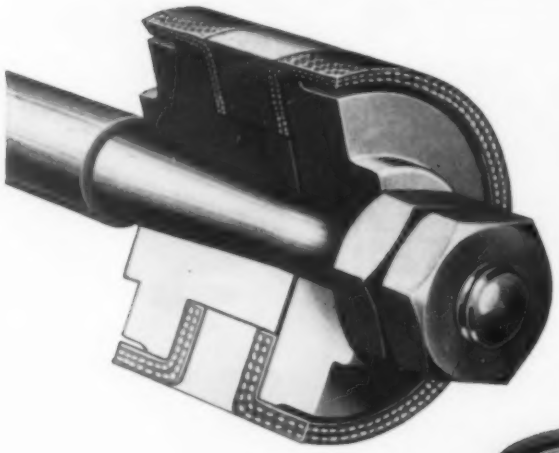
If you are trying to incorporate a pump and a motor into a limited space Tuthill has the answer. An experienced Tuthill field engineer will be happy to give you the details. Write today.

Tuthill manufactures a complete line of positive displacement rotary pumps in capacities from 1/3 to 200 GPM; for pressures to 1500 PSI; speeds to 3600 RPM.

TUTHILL PUMP COMPANY

981 East 95th Street, Chicago 19, Illinois

LESS FLUID SLIPPAGE!
LESS DOWNTIME!
GREATER EFFICIENCY!



...in hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova Pumcup

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK
PUMCUPS

Circle **34** *on Time-Saver Card*

LETTERS

Wants copy of paper by Prosser

TO THE EDITOR:

Please send us a copy of the paper, "Report on Flow Control Valves." It was delivered by Dennis W. Prosser at the National Conference on Industrial Hydraulics.

MUSEUM PUBLICATIONS, INC.
10 West 33rd Street
New York, N. Y.

This paper has been published by the NCIH in their PROCEEDINGS of last year's conference. *Copies can be ordered from NCIH, Illinois Institute of Technology, 3300 S. Federal, Chicago. Price is $5.00.*

Needs reports on F-R fluid compatibility

TO THE EDITOR:

In your December, 1958 issue, on page 65 under "Packings," the third answer states: "Leather impregnated with thiokol is compatible with all the fire-resistant fluids. This material has shown the least amount of swell of any material with the exception of Teflon." We have made certain tests on similar packings of our own which support these statements. Do you have any reports spelling this out completely?

J. M. BRADLEY
C. W. Marsh Co.
Muskegon, Mich.

We do not have any report-type information on this process.

Asks about symbols for circuit diagrams

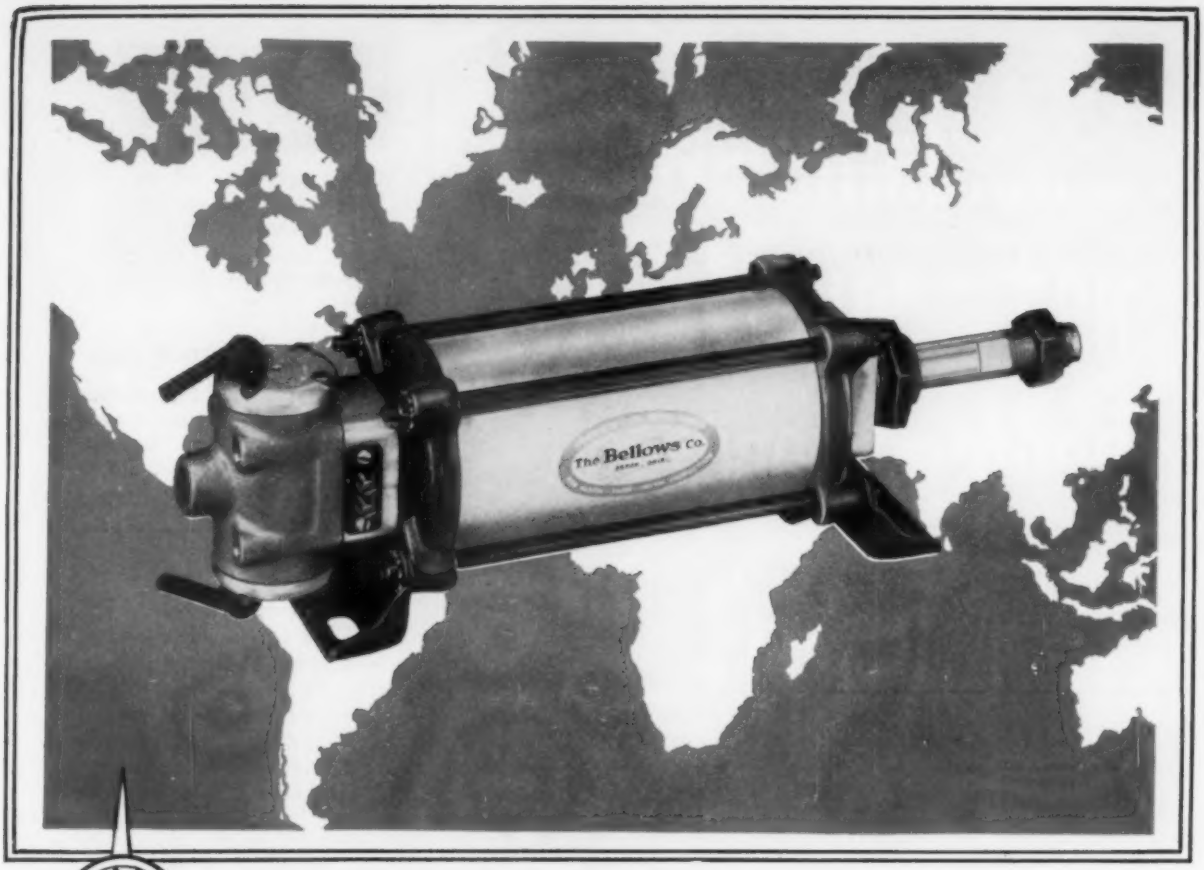
TO THE EDITOR:

Circuit diagrams in your magazine use functional symbols to represent valving and other circuit components. Where can I obtain a key to this standard representation?

JOHN H. JOHNSON
Research Engineer
Marlin-Rockwell Corp.
Jamestown, N. Y.

The symbols are from the JIC Standards. These standards are a

Continued on page 18



SERVICE AVAILABILITY IS ANOTHER MAJOR REASON WHY OEM DESIGNERS SPECIFY BELLOWS AIR MOTORS

In your products, as in ours, service to customers is an important selling tool. When you specify Bellows Air Motors and other Bellows pneumatic devices and controls as components in your machines—you know, wherever the machine will be shipped, there will be a Bellows Field Engineer nearby.

Over 150 full time, fully trained Bellows Field Engineers, in every important industrial area in the United States and Canada, in Great Britain, in Europe, and Australia are available to give quick, efficient and friendly help if it's needed. And seven manufacturing and assembly plants in the States, in Canada, in Great Britain and Europe safeguard your customers from "down time" due to "parts" delays.

Add to "service availability" the design and cost advantages this unique air cylinder with the built-in valve offers you: compactness, speed, precision-control and low cost—and it's easy to see why the Bellows Air Motor ranks first with design engineers.

This booklet tells the story "The Place of the Bellows Air Motor in Original Equipment Design" tells in 14 quick-reading pages how the Bellows Air Motor can fit into your program. Free on request. Address Dept. AH-859, The Bellows Co., Akron 9, Ohio.

The Bellows Co.

DIVISION INTERNATIONAL BASIC ECONOMY CORPORATION

AKRON 9, OHIO

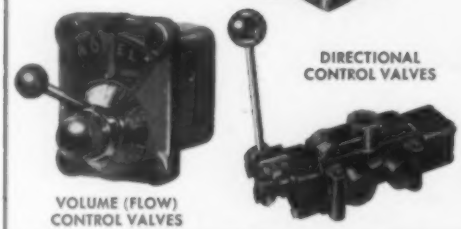
1029-8

Circle **20** *on Time-Saver Card*

ADEL *Reliability in Your Hydraulic Systems*

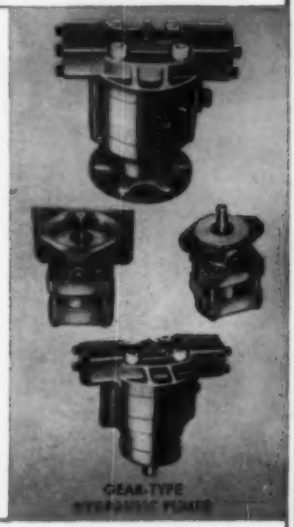
BETTER MACHINE CONTROL...
FOR BETTER MACHINE PERFORMANCE

PILOT OR SOLENOID OPERATED VALVES



DIRECTIONAL CONTROL VALVES

VOLUME (FLOW) CONTROL VALVES



GEAR-TYPE HYDRAULIC PUMPS

New Industrial Gear Type Hydraulic Pumps with capacities from ¼ to 35 GPM at pressures to 1500 PSI and speeds to 3600 RPM.

The diagrams show but two of innumerable circuits and systems where these versatile pumps and control valves can be used to advantage.

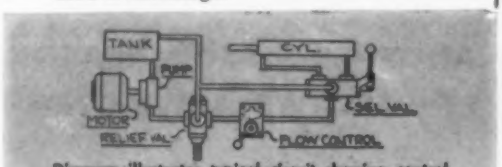


Diagram illustrates typical circuit showing control of cylinder.

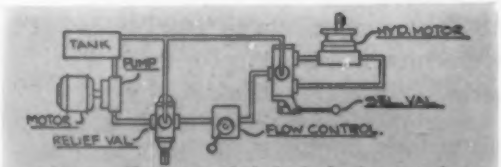


Diagram illustrates typical circuit showing control of hydraulic motor.

For metal working machines, industrial equipment, farm machinery, construction equipment, motor vehicles and marine applications... *Specify* ADEL *Precision-Engineered Hydraulics* for every mechanical operation in every industry.

Complete engineering specifications are available upon request.

Reliability
ADEL PRECISION PRODUCTS
A DIVISION OF GENERAL METALS CORPORATION

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Milwaukee 17

LETTERS

major portion of our July, 1959 magazine and are available as reprints. Single copy price is 75 cents.

use the
TIME SAVER CARD
to get more information on any product mentioned in our product reviews, useful literature or advertised in this issue.

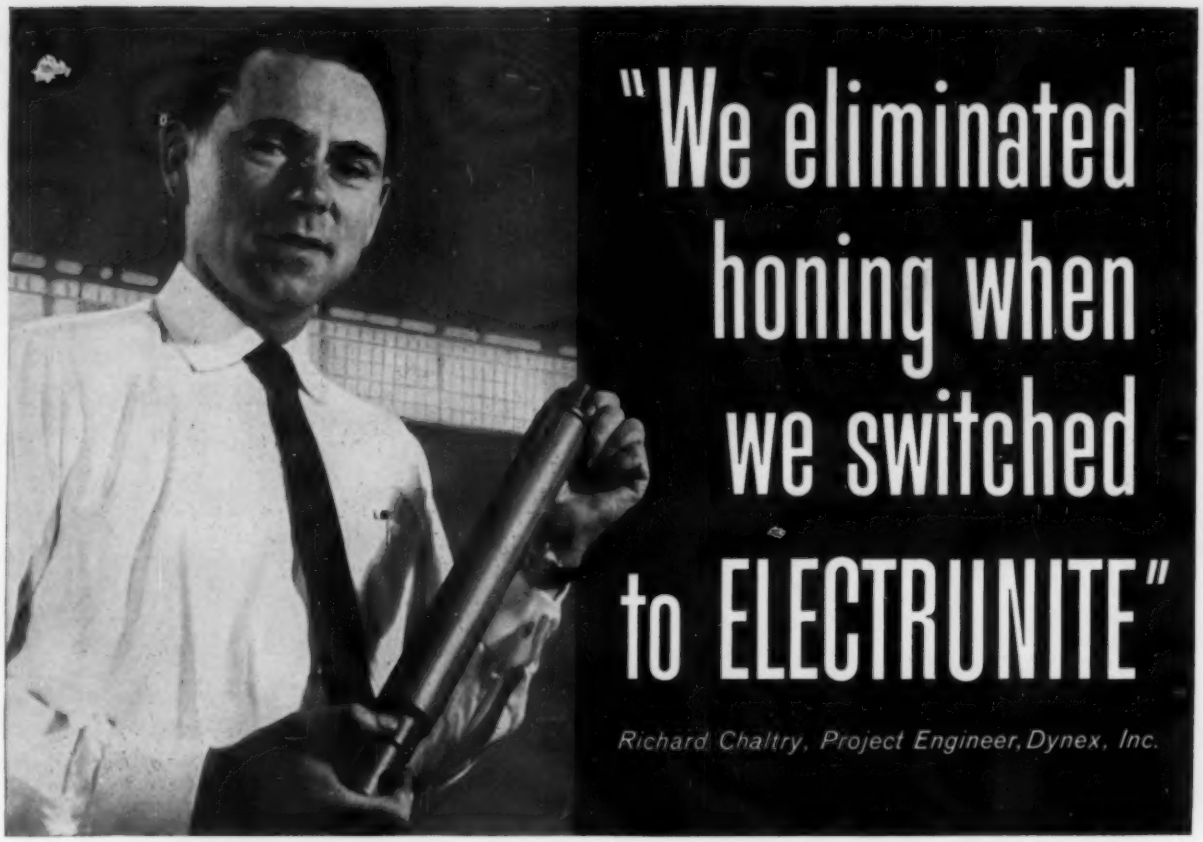
Points out error in June issue

TO THE EDITOR:

I was very much interested in your article in June, reporting on the Vickers' Fabricating Machinery forum. Your section on Circuits and Systems, reporting on new developments in leakage control, appears to be in error where it states that, "New JIC standards make straight threads preferable. Also, the standards eliminate Dryseal requirement for pipe threads." My notes from the JIC session indicate that Section H4.1.6E had reverted to the old JIC standards but without the asterisk. This read, "All pipe threads shall be Dryseal American (National) Standard taper pipe threads (NPTF)." There was quite a bit of discussion about the need of the Dryseal form in this meeting, but my notes indicate that the consensus of the group was that the Dryseal form was preferred over the American (National) Standard form, since the former could be expected to seal if properly made and applied, whereas the latter is almost impossible to seal without some auxiliary sealing means.

Z. J. LANSKY
Chief Engineer
Hannifin Company
Des Plaines, Ill.

You are right, the statement in our report of the Fabricating Machinery Forum is incorrect. Complete JIC Standards were published in APPLIED HYDRAULICS & PNEUMATICS' *July issue. Dryseal threads for pipe are retained.* □□□



"Tailor-made" ELECTRUNITE® Special Smooth I. D. Hydraulic Cylinder Tubing proves superior for single- and double-acting cylinders

"We've only been using Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing since 1957," says Mr. Richard Chaltry, Dynex, Inc., Pewaukee, Wisconsin. "But with the closer tolerances and greater uniformity you get with welded tubing, it *doesn't take long* to realize substantial cost savings.

"ELECTRUNITE is used in both our single- and double-acting cylinders. In the latter type, packing is mounted on the ram and contact is made against the I.D. wall of the tube. ELECTRUNITE, delivered to our micro-inch tolerance specifications, gives us smooth surfaces that need no honing.

"Smooth I.D. surfaces aren't a big factor on our single-acting cylinders. These are top-packed at one end against the plunger and the gland. Just the same, uniform concentricity and wall thickness are important. With ELECTRUNITE, we get a 'tailor-made' tube . . . at lower initial cost . . . from a company that *knows* our problems and requirements."

INVESTIGATE THE MANY COST REDUCING FEATURES of Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing. It is available in a wide range of sizes and wall thicknesses regularly used in hydraulic cylinder applications. For complete information, contact your ELECTRUNITE sales representative or mail the coupon.

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STEEL AND TUBES DIVISION

REPUBLIC STEEL

Cleveland 8, Ohio

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Please send complete information on Republic ELECTRUNITE Special Smooth I.D. Hydraulic Cylinder Tubing.

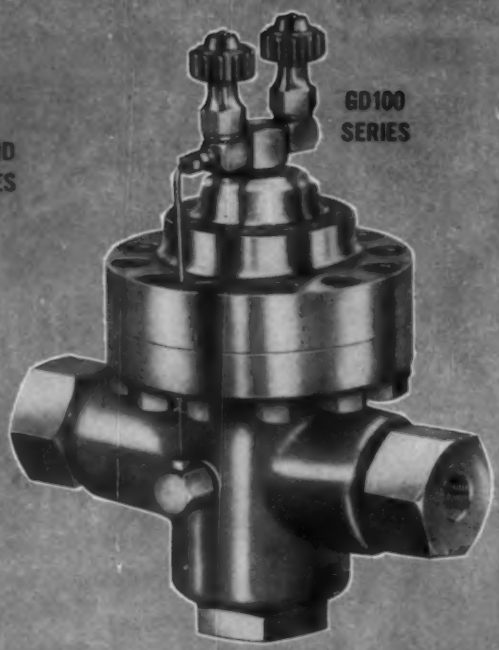
Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

GD60 AND 80 SERIES



GD100 SERIES

LR20B SERIES

Control gases safely, accurately

TO 15,000 PSI AND 50,000 SCFM WITH VICTOR REGULATORS

You get precise regulation of high pressure gases with large flow rates, because Victor employs gas pressure to control the regulating diaphragm. The result is accurate delivery from 5 to 15,000 psi with inlet pressures to 15,000 psi . . . plus ability to obtain flows in excess of 50,000 scfm at maximum inlet and outlet pressures. Chart below shows operating range of standard models.

MODEL NO.	MAX. INLET PSI	MAX. OUTLET PSI	FEATURES	MAX. FLOW SCFM
GD10	3,600	500	Single adjustment regulator control	250
GD30	2,500	2,500	Load & bleed valve control	400
GD31	3,600	3,600	Load & bleed valve control	600
GD61C	2,500	2,500	Load & bleed valve control	170
GD62C	3,600	3,600	Load & bleed valve control	200
GD65	6,000	6,000	Load & bleed valve control	250
GD65C	7,000	7,000	Load & bleed valve control	250
GD80A	5,000	5,000	Load & bleed valve control	500
GD81A	10,000	10,000	Load & bleed valve control	800
GD86R	10,000	10,000	For remote control only	1,200
GD100R	6,000	6,000	For remote control only	20,000
GD100	6,000	6,000	Load & bleed valve control	20,000
GD200	6,000	6,000	Load & bleed valve control	50,000
GD700	7,000	7,000	Single adjustment regulator control; self relieving	250
SR10	3,600	1,000	Small, spring loaded regulator	4
LR20B	7,000	7,000	Spring loaded regulator; self relieving	2
LR20BSS	10,000	10,000	Spring loaded; stainless steel	2
LV10	7,000	7,000	Loader valve control	15
BPR10	7,000	7,000	Back pressure regulator	2

Operating temperature range: −67°F. to +250°F.

. . . Yours for the asking Take advantage of Victor's long experience with high pressure gas regulation to help solve your special problems involving flow rates, delivery pressures, corrosive fluids and temperature compensation. Write, wire or phone us today. No obligation.

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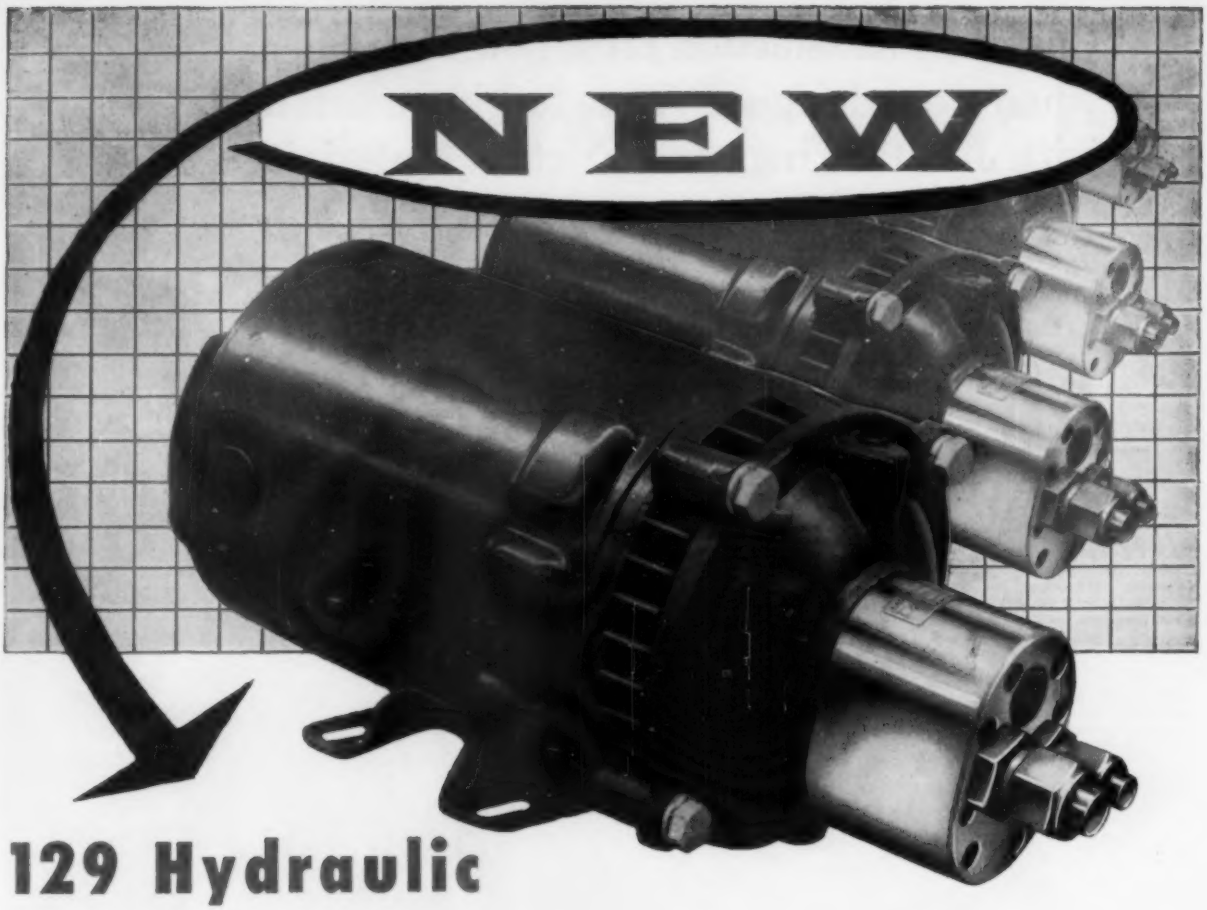


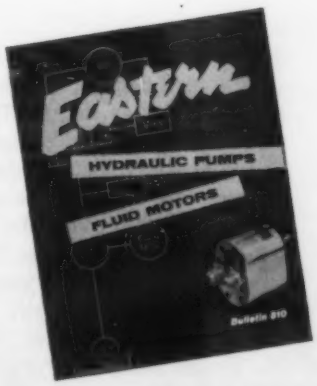
129 Hydraulic Pump and Motor Combinations

Here are power sources for any hydraulic application. Commercial, military, and aviation research have developed this array of standard pump and motor combinations.

With a performance range from .1 to 5 G.P.M. at pressures to 2000 P.S.I., you can expect a stock power source that fits your requirements. Many types of motors offer a choice of electrical characteristics, and have drip-proof, totally enclosed, or explosion-proof enclosures as required.

Typical uses are hydraulic power for machine tools, automatic door openers, material handling equipment, and thousands of other applications requiring smooth, dependable hydraulic power.

When you need custom equipment, call on Eastern and discover how this adaptable line of hydraulic pumps and motors fills the bill without research expense by you.



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EASTERN INDUSTRIES PUMP DIVISION

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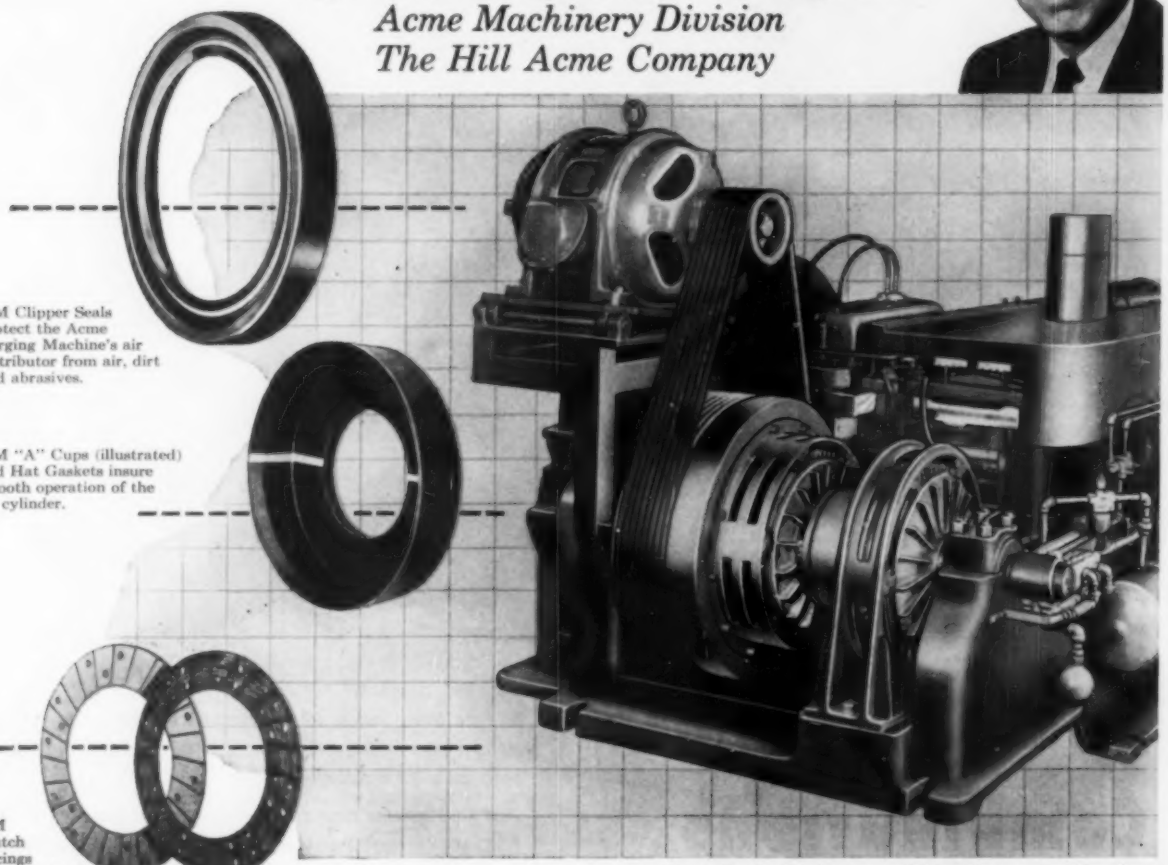
"Customer satisfaction hit a new high when we redesigned Acme forging machines with J-M Packings and Friction Materials,"

says M. W. Lamprecht, Chief Engineer
Acme Machinery Division
The Hill Acme Company



J-M Clipper Seals protect the Acme Forging Machine's air distributor from air, dirt and abrasives.

J-M "A" Cups (illustrated) and Hat Gaskets insure smooth operation of the air cylinder.

J-M Clutch Facings (illustrated) and Brake Linings play integral parts in the Acme Forging Machine's cushion drive mechanism.

Acme Forging Machines are widely used by metalworking plants all over the world. They are made by Hill Acme Co., pioneers and leaders in construction and design of modern forging machines.

J-M products defy extreme thermal and mechanical shock for dependable performance and long life

In terms of thermal and mechanical shock and the constant presence of dirt, chips and other abrasives, Acme Forging Machines provide one of the most rugged tests ever devised for packings and friction materials. In more than 20 years of service, Johns-Manville products have achieved an enviable record with Acme users. Performance has been more than satisfactory in every way and replacement has been held to the minimum.

Johns-Manville makes a complete line of packings, gaskets, asbestos textiles, brake linings, clutch facings, transmission bands and industrial friction materials. Chances are one or more of these products may provide the answer to your design problems. For further information call your local J-M sales office or write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

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CHECK VALVES

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5. Available in ¼" thru 2" sizes in both screw and socket weld ends

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*Product of Union Carbide Corp.

BRIEFS

about fluid power

DOUBLE-INDEX SYSTEM HANDLES PUMP BODIES

An unusual double-index system with two-position fixtures is the answer to handling a variety of similar parts having differences in locations and sizes of holes. The compact special center-column type machine tool uses this unique system in processing a variety of cast iron and aluminum pump bodies at 100 parts per hour, according to the Snyder Corporation of Detroit.

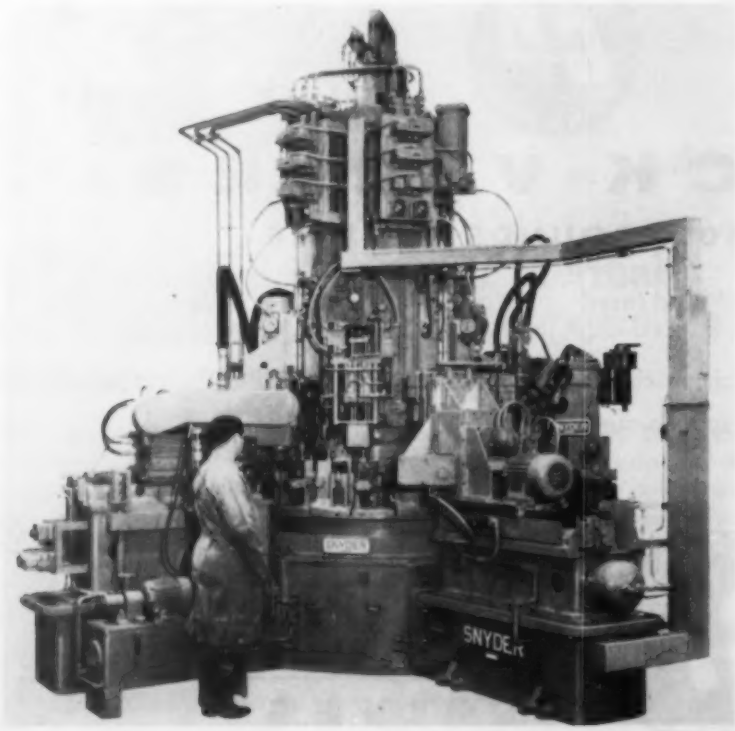
By providing all machining heads with change gear boxes, differences in part materials are accommodated. The drilling and tapping head spindle speeds are increased for aluminum parts by reversing a pair of drive gears.

To provide maximum machining operations, eight 2-position fixtures are indexed through 16 stations, providing a finished machined part every other index of the table.

Automatic hydraulic clamping and unclamping is provided to simplify and indicate the loading and unloading function.

Changeover from one part to another of the same removal is accomplished by removing a few tools and inactivating certain machining heads.

The new machine is hydraulically operated, with separate pump and tank units to provide hydraulic power. A mechanism built into the machine base hydraulically indexes the table. □□□



NCIH Plans 11 Technical Sessions for Oct. 22-23

A total of 11 technical sessions are planned for the 15th Annual National Conference on Industrial Hydraulics in Chicago, Oct. 22-23.

Appearing at the general session will be Dr. G. J. Matchett of I.I.T. He will present a paper on the principles of purchasing and replacing industrial equipment.

At the components and accessories session, papers on testing hydraulic circuits and a central hydraulic system will be presented. A paper on assembly equipment and a panel discussion on shop air systems will feature the pneumatics section.

In the pumps session, reports on servo control pumps and variable volume pump control will be heard. Machine tools will highlight papers on methods for instrumenting electro-hydraulic servo systems and designing components for electro-hydraulic servomechanisms.

Power spinning and impact forming, plus a paper on servo valves will be presented during the materials forming machinery session. Papers on hydrostatic transmissions for mobile equipment and higher pressure hydraulic systems will highlight the mobile equipment talks.

At the servomechanisms session, discussions of servo valve

Continued on page 26

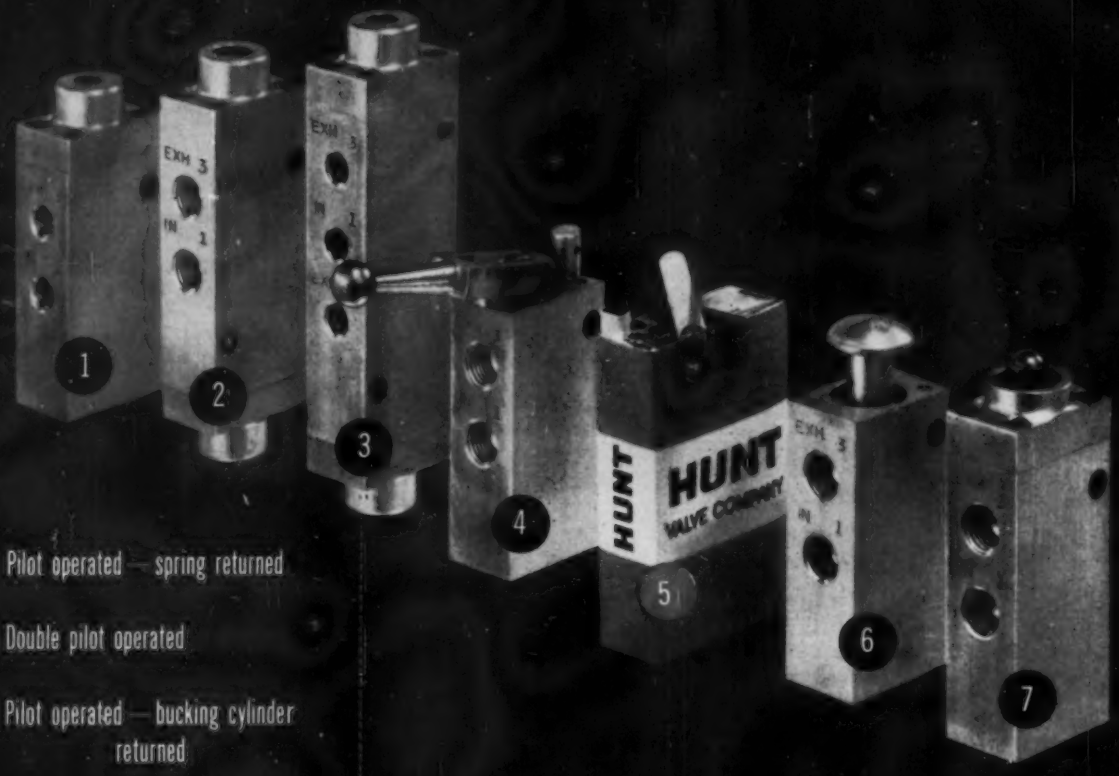
Circle 58 ➡

another

new valve

by **HUNT**

the **TRIM LINE**



1. Pilot operated — spring returned
2. Double pilot operated
3. Pilot operated — bucking cylinder returned
4. Lever operated
5. Reserved for valve actions to come
6. Palm-button operated
7. Ball actuated

An unbelievably small valve with a long, long life

Priced economically . . . that's TRIM LINE, Hunt's newest valve in a series of new valve designs.

The TRIM LINE is available in 3-way and 4-way actions. Furnished tapped for either ⅛" or ¼" pipe connections.

Designed for installations where space is limited, TRIM LINE is a quality valve you can depend on to work right . . . and to LAST. Just replace the "O" rings and it works on and on and on.

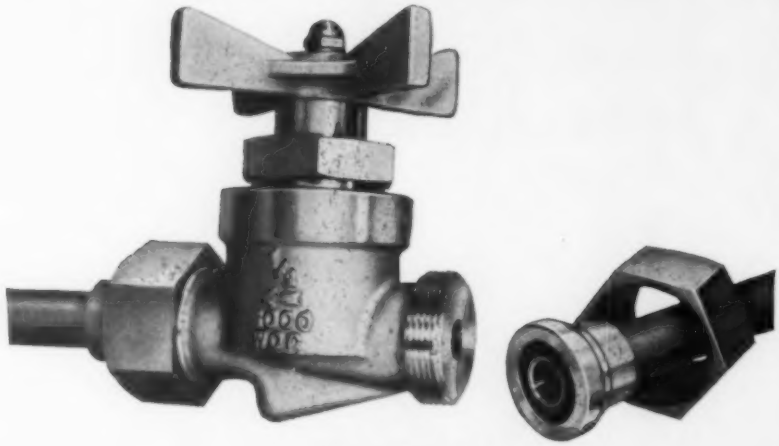
For complete details write to . . .

HUNT VALVE COMPANY • SALEM, OHIO, U.S.A.

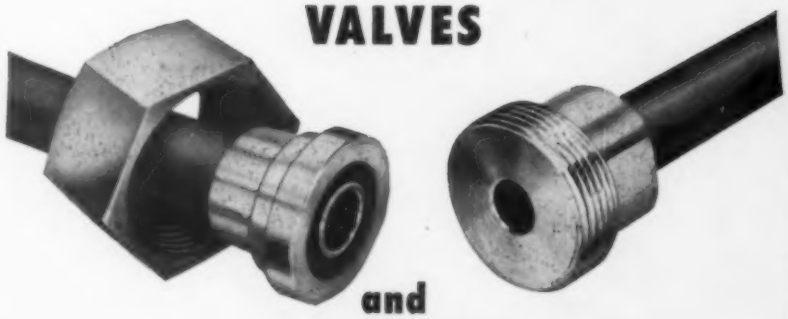
HUNT *Quick-As-Wink* AIR & HYDRAULIC CONTROL VALVES

NOW ADD FLEXIBILITY TO YOUR HIGH PRESSURE LINES

with CPV O-SEAL SYSTEM



VALVES



and FITTINGS

With the exclusive CPV O-SEAL SYSTEM, you can quickly install valves or complete piping sections in new or existing high pressure lines—and remove them at will without burning or springing the line. Down time for valve or line inspection, replacement or relocation is reduced to an absolute minimum. Since *final* connection is made without welding, brazing or high torquing, any danger of valve distortion is eliminated.

This unmatched flexibility is achieved with full assurance of leak proof connections at rated pressures to 5000 psi or more. Positive sealing and hand operation of the valves under all service pressures and conditions are unique features of CPV O-SEAL SYSTEM construction.

CPV O-SEAL SYSTEM valves and fittings are available in all standard sizes from ¼ inch to 2 inch. For complete information and specifications, write today for Catalog 59.

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BRIEFS

application with flow feedback, and a tape command electro-hydraulic machine tool control will be held.

Guided missile hydraulic servos and the gyroscopic mass flowmeter will be subjects of papers at the space hydraulics forum.

A review of hydraulic filtration has been announced as one subject for the aircraft systems session.

At the automotive session a paper on automatic braking control has been planned.

This year's conference is being held at Chicago's Hotel Sherman. For reservations write Raymond Meade, Conference Secretary, NCIH, Technology Center, Chicago, Ill. □□□

MAGNETIC MOUNTING of a cup packing on a piston was demonstrated at the recent Design Engineering Show. The tiny magnet is totally cased in the magnetic follower plate whose shoulder contacts the piston plane face through the packing center hole. According to E. F. Houghton & Co., Philadelphia, the resulting mount is self-centering, inexpensive to install, compensates for "out-of-round" cylinders, eliminates squeezing the cup bottom by overtightening, and permits the packing to breathe.

Linear Solenoid For Servo Systems

Designed in France for hydraulic servomotors used to adjust the pitch of propellers, this solenoid has linear characteristics.

An unusual construction feature is the annular permanent magnet with lines of force perpendicular to its axis. Its inner and outer cylindrical surfaces form the poles. The two diaphragms locate the

Continued on page 28

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NOW A COMPLETE FAMILY OF SMALL AIR VALVES, MANIFOLDS, ACCESSORIES

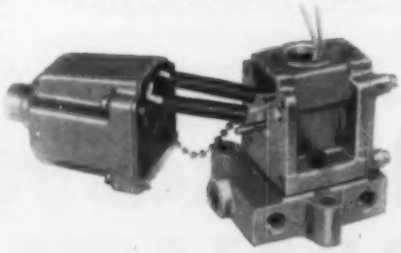
NUMATICS' New SA Junior Series

You've found it! . . . the answer to *all* your small air valve requirements. It's the new *SA Junior* Series . . . Numatics' small, precision-built, heavy duty family of valves and manifolds. Two valve types (above), many model varieties . . . three different sub-plates . . . three operator options and four styles of manifolds to provide application versatility unlimited.

SA Junior, what's more, gives you *quality* throughout . . . Numatics' famed patented lapped spool-floating sleeve action . . . corrosion-resistant aluminum body . . . continuously rated, heavy duty solenoids . . . J. I. C. conformance . . . all this plus a ruggedness and reliability to handle 60% of all your air jobs at an average 40% reduction in air valve costs. Send for a catalog today!

"Solenoid Capsule" Design—Another NUMATICS' FIRST!

Typical of SA Junior quality and design ingenuity is the unique, new "Solenoid Capsule" . . . a Numatics' *exclusive*. Solenoid and cover are a self-contained, J. I. C. approved assembly which eliminates loose parts when the solenoid cover is removed.



NUMATICS, Inc.
HIGHLAND, MICHIGAN

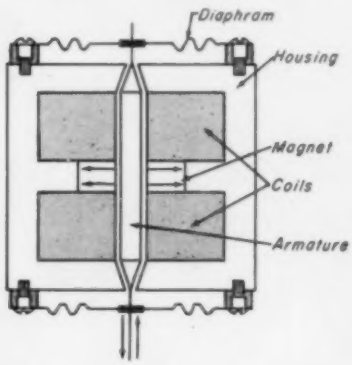
BRIEFS

moving armature in the permanent magnet, and the two coils are enclosed in the housing which forms the magnetic circuit.

The permanent magnet has low permeability in relation to the electromagnetic flux. Total flux in one of the two conical air gaps is the sum of the two individual fluxes; in the other, it is the difference of the two fluxes.

However, overall value for both air gaps remain constant since total flux is independent of the armature displacement.

Force applied to the moving armature is proportional to the electromagnetic flux at one of the air gaps. If this electromagnetic



flux is proportional to the current through the coils, force will be proportional to the current and armature displacement.

Since it is possible to make the mechanical force applied to the armature by the diaphragm proportional to the displacement, the final result is that armature displacement is proportional to signal received throughout almost the entire armature travel.

The coil is in two parts so it can be used for differential regulation. One part is energized by the actuating signal and the other by a signal proportional to the deviation in the system. Damping is provided by an adjustable orifice in one or both diaphragms. The two chambers between diaphragm and housing may also be connected by a passage with adjustable orifice to obtain symmetrical, selective damping. □□□

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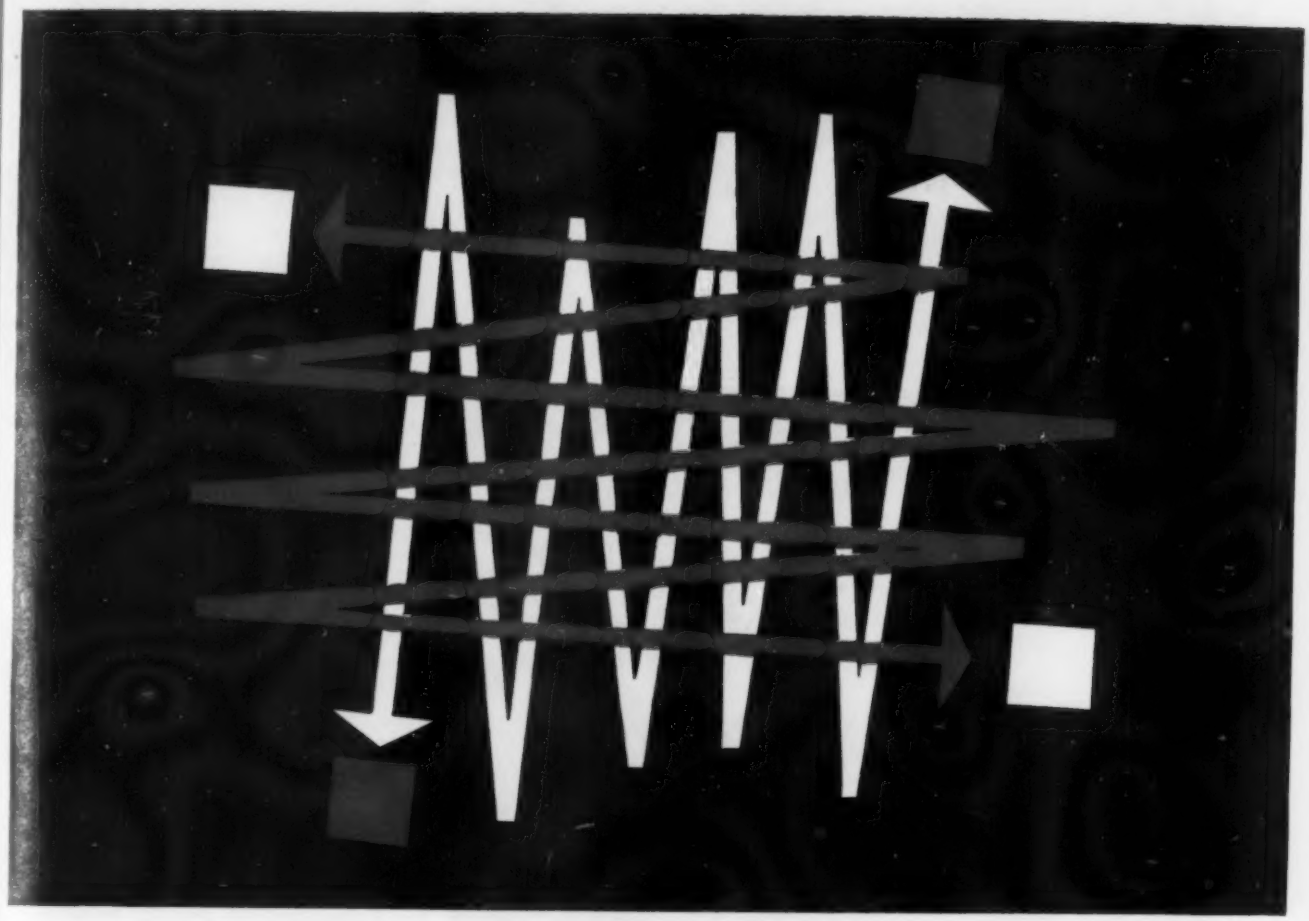

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BRIEFS

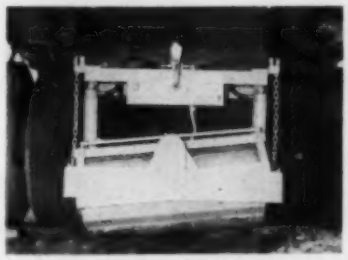
Fluid Power Diagrams Available in Book

Fluid Power Diagrams, Section 17 of the American Drafting Standards Manual, has been approved and is now available in book form. It establishes standard drawing practices for depicting systems using a fluid within enclosed circuits to transmit and control power.

Explained carefully are all data and notes used to accompany symbols and lines for diagrams. Pictorial, cutaway, graphical, and combination diagrams are covered.

Standard symbols illustrated for each type of diagram include components, piping, capacity, power, and other ratings.

Copies, at $1.50 each, are available from the American Standards Association, 70 E. 45th St., New York 17, or The American Society of Mechanical Engineers, 29 W. 39th St., New York 18. □□□



AN ELECTRICALLY-OPERATED hydraulic pump raises and lowers a road patching roller made by Martin Co., Kewanee, Ill. The Tiltable Patcher is mounted under a truck frame and is lowered to roll a smooth, permanent asphalt patch. This permanency is due to using controlled compaction pressure maintained by hydraulic pressure against truck weight. Regardless of truck position, the roll follows road surface as it is center pivoted. By using the weight of the truck, more than 3½ tons of pressure can be put on the roller although the patching unit weighs only 700 lb.

Porous Metal Filter Advances Cited

Fabrication of porous metal filters and uses of exotic metals for special industrial filtration units were discussed by research engineers from Purolator Products, Inc., at the 15th annual Powder Metallurgy Show.

Growing uses of powder metallurgy in the design and manufacture of industrial filters were discussed. A clinic discussion centered on convoluted porous metal elements of many sizes and shapes; powder on metal-edge filters, plus many gold, silver, platinum, nickel, chromium, inconel, monel, and stainless steel units.

Exotic metal units were reported as finding a limited use in industry.

The convoluted metal element is fabricated of many metals in extreme designs to meet rigid specifications of extremely low and high pressures (to 10,000 psi) and temperatures (—420 F to + 1200 F). □□□

Continued on page 32

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Hydraulic Cylinders

- Basic Designs
- Specific Adaptations
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- Application Engineering

THIS IS BHEW'S "DUAL PILOT" CHECK VALVE. It insures positive piston rod lock in any position when the directional control valve is in neutral. You *know* the rod will not drift. This simplifies hydraulic line circuitry, eliminates separate pilot operated check valves, connections and lines.

• BHEW furnishes hydraulic cylinders with single or dual P.O.C. valves, with or without speed control.

Production parts save you money, do the job better! BHEW basic cylinders can easily be modified to fit your *specific* product applications. You benefit from production economies; you get custom-built cylinders.

Let's discuss your design and application problems —

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Write today for Hydraulic Cylinder Engineering Reference data — 78 dimensional basic designs for general-purpose and special-purpose double-acting and single-acting cylinders. SAVE TIME.

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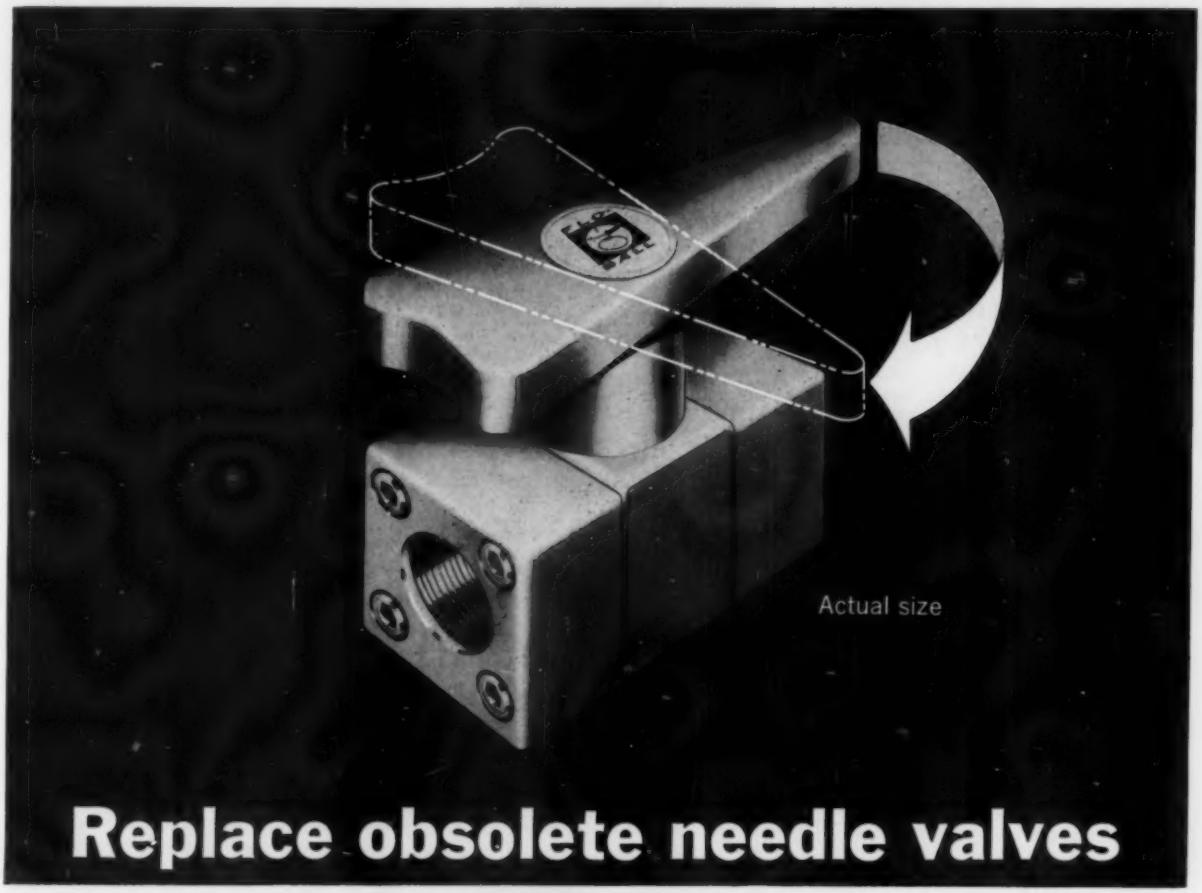

Replace obsolete needle valves with the NEW 90° ON-OFF *FLO-BALL*

For 3,000 PSI...

Low torque, instant action . . . a fast 90° turn, requiring just 4 inch-pound torque at 3,000 psi, actuates the valve instantly!

Priced no higher than needle valves!

100% flow efficiency . . . straight-thru ***FLO-BALL*** design has more than twice the flow efficiency of needle valves!

Positive ON-OFF indication . . . large arrow-shaped handle shows valve position at a glance!

Zero leakage . . . Mass Spectrometer tests with Helium prove zero leakage!

Universal mounting . . . can be panel, side, bottom, or line mounted!

Removable flanges . . . damaged flanges can be removed in seconds; no need to replace entire valve!

All stainless steel construction . . . costs no more than old fashioned screw-type valves!

Versatile service . . . ideal for leakproof control of air, vacuum, steam, water, fuels, oils, kerosene, alcohol, and many other fluids.

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Port Styles and Sizes			
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Size	Part No.	Size	Part No.
⅛	715A1	¼	715A2
¼	715B1	⅜	715B2

Other models are available for service with cryogenic and corrosive media. Also special designs for throttling flow control.

Write today for new catalog describing the world's most complete line of precision valves for industrial and military applications.

FLO-BALL

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SPECIAL REPORT ON MINIATURIZATION OF SOLENOIDS:

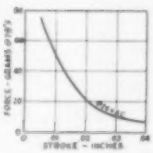
3/8" Diameter Solenoid Developed by PSP

A miniature solenoid, delivering 10 grams of pull at .030" stroke, has been developed by PSP Engineering Company, Maywood, California. The new 3/8" diameter solenoid complements PSP's existing line of miniature and sub-miniature solenoids.

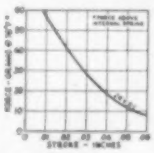
All PSP solenoids (800 designs) are made in general accordance with MIL-S-4040C specifications. Following are general specifications on representative types of PSP miniature solenoids and their accompanying force curves:

DC PULL, SINGLE COIL CONSTRUCTION TYPES

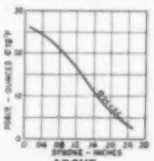
PART NO.	4SD819-2
VOLTAGE RANGE:	24 to 30 VDC continuous duty
CURRENT DRAIN:	.030 amp @ 24 VDC @ 78°F
TEMP. RANGE:	−65°F to +160°F
WEIGHT:	Unit 9.2 grams, plunger 0.9 grams
SIZE:	3/8" dia., 3/4" lgth.



PART NO.	5SD466-5
VOLTAGE RANGE:	24 to 29 VDC continuous duty
CURRENT DRAIN:	.100 amp @ 28 VDC @ 78°F
TEMP. RANGE:	−65°F to +240°F
WEIGHT:	Unit 9.6 grams, plunger 0.4 grams
SIZE:	1/2" dia., 1/2" lgth.

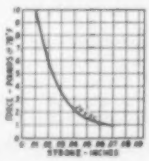


PART NO.	7SD756-2
VOLTAGE RANGE:	25 to 29 VDC intermittent duty (20 sec. on, 15 min. off)
CURRENT DRAIN:	.800 amp @ 24 VDC @ 78°F
TEMP. RANGE:	−32°F to +170°F
WEIGHT:	Unit 1.8 ozs., plunger 0.013 ozs.
SIZE:	5/8" dia., 1 1/2" lgth.



ABOVE INTERNAL SPRING

PART NO.	8SD328-4
VOLTAGE RANGE:	18 to 30 VDC continuous duty
CURRENT DRAIN:	.535 amp @ 24 VDC @ 78°F
TEMP. RANGE:	−65°F to +165°F
WEIGHT:	Unit 1.59 ozs., plunger 0.24 ozs.
SIZE:	3/4" dia., 1 1/4" lgth.



Information on PSP solenoids, as well as complete information on synchro components and step-servo motors manufactured by our company, is available when requested on company letterhead.

PSP engineering company

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DIVISION OF
tmC MAGNETICS CORP., N.Y.
6060 Walker Avenue, Maywood, California
LUdlow 3-4785
Representatives in principal cities

Circle **92** *on Time-Saver Card*

BRIEFS

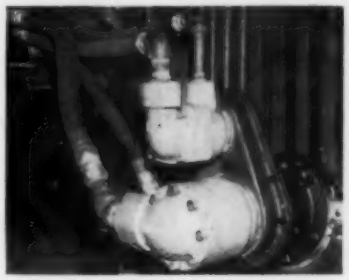
Hydraulic Drill Speeds Rock Drilling

Two 2000-psi vane pumps supply power for jacking, drilling and mast erection on this mobile drilling tractor for strip mining coal.

To assure a rugged platform from which to operate, a system of hydraulic jacks level and support the tractor. The jacks are controlled through a master control panel and work on grades to 15 degrees.

A revolving standard storing three sections of drill to make fast, simple changes is part of the main mast. The rack positioner is rotated by a cylinder.

Engineers at Robbins Coal Co. in Oneonta, Ala. who designed the tractor, mounted the pumps on a rear power take-off of the tractor. A power transmission with four speeds forward and double reverse provides various drill speeds from 20 to 140 rpm. Two hydraulic cylinders push



down on the drill bit with as much as 30 tons force.

Drill pipe joints are broken by a hydraulic cable puller. The reverse gear of the rotary drive uncouples the pipe. Forward gears couple the pipe. Cuttings from the blast hole are ejected by compressed air from a rotary compressor on the tractor. □□□

Continued on page 34

BRIEF NOTES

A BIG STEP TOWARD . . . developing a curriculum in oil/industrial hydraulics has been announced by the Milwaukee School of Engineering. An Industrial Advisory Committee for Hydraulics, chairmanned by Russ Henke, has set up two courses for the 1959-1960 school year. The first, Basic Hydraulics, will be offered in September, with Advanced Industrial Hydraulics to follow in February, 1960.

ANOTHER USE FOR TEFLON . . . A new series of spherical bearings, rod end bearings, and bushings using Teflon has been developed to operate without lubrication. Price is close to all-metal counterparts. Projected use seen for aircraft, construction equipment, oil field drilling, food processing, agriculture, and textile machinery.

ELECTRICALLY CONTROLLED PRESSURE . . . As an answer to the need for remote, rapid, variable control of pressure, Denison Engineering Division has introduced an electro-hydraulic valve. It's the basic pilot-operated pressure control valve (relief, sequence, reducing) with an electrical control head. Permits remote control of pressures to 5000 psi.

BUSINESS BRIEFS

FLUID POWER DOLLARS . . . In February the Business and Defense Services Administration (BDSA) sent a survey to 580 manufacturers of pumps, fluid motors, cylinders, compressors, valves, and accumulators. Available returns from 250 companies give an approximate 1957 sales volume of $485,136,000.

AEROQUIP PLANS EXPANSION . . . during the next 18 months, according to President Peter F. Hurst. The record $2.4 million expenditure program will provide 140,000 sq. ft. of working area. Included are a new plant and center, three extensions and additions, and a special rocket-missile product test laboratory.

AIR-MAZE BECOMES A SUBSIDIARY . . . of Rockwell-Standard Corp., Coraopolis, Pa., after a recent $4 million transaction. With its single 500-employee plant in Bedford Heights, Ohio. Air-Maze has been a leader in the filtration equipment field. Oliver A. Schaaf, Air-Maze president, will stay on in an advisory capacity. Rockwell-Standard annual sales in recent years have reached $300 million.

With Extras . . . At No Extra Cost

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
4. ONE PIECE PISTON assures better alignment, longer bearing and packing life.
5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

Specify the

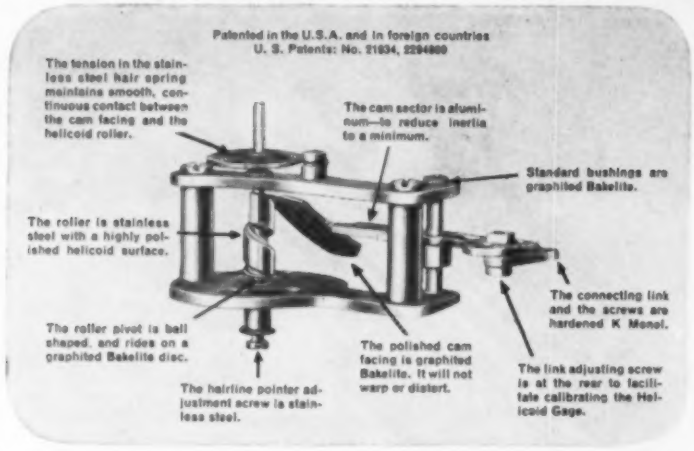
T-J Spacemaker

for longer, more efficient cylinder service

You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space . . . and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities . . . air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.

T-J TOMKINS-JOHNSON
RIVETORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS


Patented in the U.S.A. and in foreign countries
U. S. Patents: No. 21634, 2294809
The tension in the stainless steel hair spring maintains smooth, continuous contact between the cam facing and the helicoid roller.
The cam sector is aluminum—to reduce inertia to a minimum.
Standard bushings are graphited Bakelite.
The roller is stainless steel with a highly polished helicoid surface.
The connecting link and the screws are hardened K Monel.
The roller pivot is ball shaped, and rides on a graphited Bakelite disc.
The polished cam facing is graphited Bakelite. It will not warp or distort.
The link adjusting screw is at the rear to facilitate calibrating the Helicoid Gage.
The hairline pointer adjustment screw is stainless steel.

Exclusive Helicoid movement provides...
Sustained Accuracy... on the toughest jobs

• Helicoid Gages have no gears, no teeth, reducing wear to an absolute minimum. No danger of fouling, either—rolling action of cam facing keeps contact surface clean. Helicoid Gages have been tested through 75,000,000 cycles, with virtually no wear or loss of accuracy, while conventional geared gages became useless after 500,000 cycles.

Helicoid Gages give *sustained* accuracy even when subjected to violent pressure pulsations or mechanical vibrations. Pointer can be set externally, without removing glass, and cannot be jarred out of position. Dial faces are easy to read, won't corrode or chip. A full range of Helicoid Gages is available for any application. Next time, specify Helicoid—the gage that *stays* accurate.

Bourdon Tubes won't Stretch, Leak, or Crack

Helicoid Bourdon tubes are made from seamless tubing, and are designed for maximum torque and minimum stress. At the factory, each tube is individually tested, overpressured, and stress relieved. Four materials—alloy steel, K Monel, stainless steel, and phosphor bronze—are available to meet applications ranging from tap water to almost any acid.

NEW! Solid-Front Safety Case Gives Added Protection

The new Helicoid solid-front case diverts the force of a burst in a backward direction, away from the operator. The force escapes by deforming, though not detaching, the back cover plate. Helicoid Gages are also available in phenol, acaloy flanged, acaloy flangeless, polished flangeless, round flush, polished flush ring, and square flush cases.

WRITE for details **Ask for Catalog DH-65**

HELICOID GAGES

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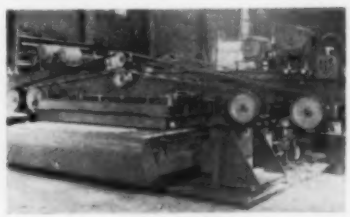
Circle **56** *on Time-Saver Card*

BRIEFS

Metallic Seals May Be Answer to "Killers" in Missile Systems

Metallic seals may subdue the "killers" of high-performance aircraft and missile systems. At least, they afford the best opportunity, according to results of one series of tests.

Charles E. Hamlin, senior test engineer with Autonetics, a division of North American Aviation, Inc., said the "killers" were temperature, pressure, and exotic fluids.



STRAIGHT LINE sanding machine has an 8 ft long platen actuated by air pressure. The machine is used for wood panel sanding. A sanding belt traveling at 5000 sfpm moves across the work while a belt made up of soft pads traveling at 1000 sfpm maintains pressure on the work. Made by Curtis Machine Division, The Carborundum Co.

Of paramount importance in the design of these seals is determining optimum material combinations, surface finishes, and relative hardness of rubbing surfaces. Hamlin said his company has developed Natorq, a metallic boss seal made from stainless steel, Inconel X, and aluminum.

In tests, Natorq has proved leakproof up to 1000 F and 10,000 psi. Hamlin said when torque is applied to the seal, it becomes an integral part of the fitting and repeated assembly and disassembly of the combination does not degrade this integrity. □□□

Continued on page 36

how to specify airline controls...

that provide longer life... maximum efficiency and protection of air-operated equipment

ALEMITE "TRI-DUTY" AIRLINE CONTROLS GIVE 3-WAY PROTECTION OF AIR-OPERATED EQUIPMENT

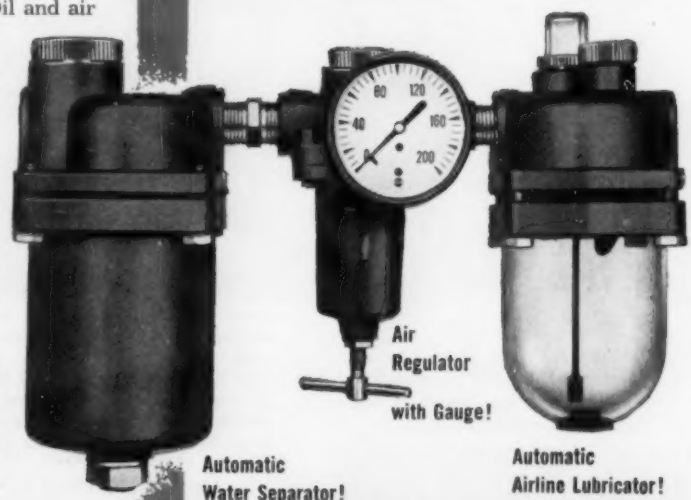
USE THIS HANDY CHECK LIST...

✓ **Are the controls uniformly and automatically lubricated?** "Tri-Duty" is equipped with an automatic airline lubricator. Exclusive compensating ball valve design controls air flow. Oil particles are atomized for most efficient transmission through supply lines. Result—uniform mixture regardless of air pressure and volume. Oil and air mixture proportionately constant. Reservoir may be filled at any time, assuring continuous operation. Nine-ounce capacity.

✓ **Is cleaning of the water separator filter quick, easy?** The Automatic Water Separator in the Alemite "Tri-Duty" system features an easily accessible filter. It unscrews by hand for simplest possible cleaning. There's just one piece. No tools required.

✓ **Will it deliver peak performance at all times**—even under adverse conditions? Alemite "Tri-Duty" airline controls provide a complete package that assures cleanest, driest, best-regulated lubrication of air cylinders, air motors and all air operated equipment. Designed specially for long service life and peak efficiency under adverse operating conditions.

✓ **Will the controls protect sensitive airlines from water, dirt?** "Tri-Duty" features an automatic water separator. Removes all condensate all the time. Traps dirt particles—prevents damage to airlines. Handles all airline pressures up to 200 PSI and flow volume from 5 to 50 CFM.



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☐ Please send me a free copy of your "Tri-Duty" Airline Controls catalog.

☐ Please have your Alemite Lubrication Representative arrange a no-obligation demonstration.

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in Viton A, Vyram, Polyurethane, and other unusual elastomeric materials having excellent resistance to many petroleum oils, synthetic lubricants, fuels, phosphate and silicate ester fluids—in a temperature range of —40° to + 500°F.

LINEAR—specialists in close-tolerance molding in all of today's modern polymers . . . in both fabric reinforced and homogeneous materials.

These are low friction seals. For further help, call the LINEAR engineer.

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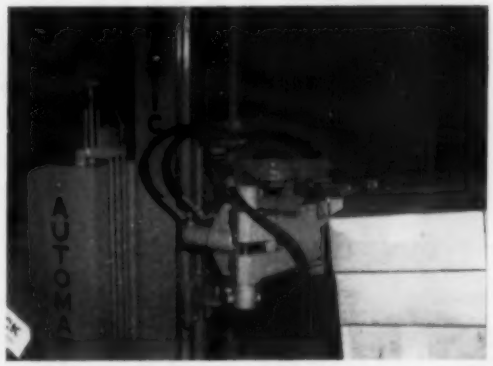
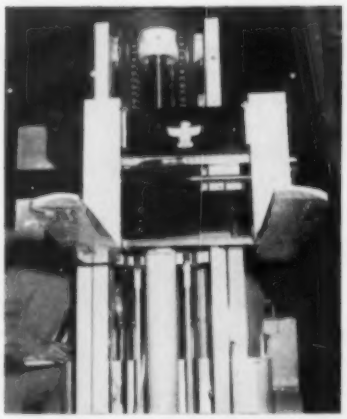
BRIEFS

LIFTING, CARRYING, PACKAGING — FLUID POWER at the Material Handling Show

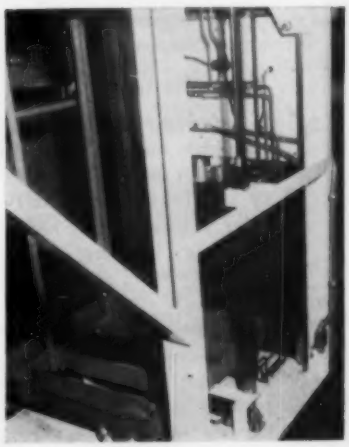
SOLENOID VALVE CONTROL — The fork **claw** for Automatic Transportation's new **crab** truck is a cylinder-actuated knuckle mechanism. It swings out 24 inches, rotates 30 degrees either side of center. Cylinders driving each knuckle are actuated together by a manual control. Two pushbuttons on the control permit actuating either one alone.





AIR-OVER-OIL SYSTEM—Air powers most motions of a pan handling machine built by Union Steel Products, but it can't control positive cylinder stopping. To lower the rack a fixed distance each time a pan slides onto it, one cylinder is actuated by oil under 90-psi air pressure.

ROLLING HOSES — On Mercury's high lifting fork truck, one problem was how to pipe fluid to the side-shifting forks. The solution is by carrying the hoses up through the mast, down below the chain anchor, and then up to the attachment cylinder.



FLUID MOTOR EXTENSION—The forks of this Clark lift truck are extended by a fluid motor driving through a ball screw for high efficiency. Two vane pumps provide 2-speed control for the hydraulic functions. The hand-controlled brakes sense the load to vary braking force. Tube connections are non-flare, sealed by a rubber cushion (pointed out by model) to permit tubing movement.

Continued on page 38

He's mopping up the mess for the last time

At a leading aircraft research center, high-frequency vibration caused severe oil leakage from hydraulic lines servicing a huge wind tunnel. Many man-hours each month were wasted cleaning up the basement floor underneath, even though drip pans were used extensively.

Now, after a change to a Suntac oil, the vibration-caused leakage has been reduced to a point where "mop-up" is not needed. Hydraulic-fluid consumption has been cut by 4000 gallons a year. That's economy! That's Sun quality—the best economy of all.

If your plant is troubled with a leaky system, a Suntac antileak hydraulic oil can save you money, too. Ask your Sun representative to show you the Suntac desk-top demonstration, or write direct to SUN OIL COMPANY, *Philadelphia 3, Pa., Dept. AH-8. In Canada: Sun Oil Company Limited, Toronto and Montreal.*

SUNOCO

MAKERS OF FAMOUS CUSTOM-BLENDED BLUE SUNOCO GASOLINES

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Now—Hydraulic Smoothness and Control from your own Air Cylinder plus a

VERI-TROL

TRADE MARK

Hydraulic Checking Cylinder

Designed for use with conventional air cylinders, VERI-TROL hydraulic checking cylinders smooth out stroke variations due to the compressibility of air under irregular load conditions. They're ideally suited for use with air cylinders operating tool or work-piece feeds, precise positioning devices, or wherever you need a smooth, uniform work stroke at any desired pre-set speed. VERI-TROL features (patents applied for) include:

- ACCURATE SPEED CONTROL is dial-set, load-compensated to assure uniform stroke speed even with irregular loads.
- BUILT IN "SKIP," "STOP" OR "SKIP-STOP" controls optional.
- VISIBLE OIL RESERVOIR, easy to refill.
- 2,000 LB. CHECKING CAPACITY on out stroke, free return.
- 2", 4", 6", 9", 12", 15" and 18" checking stroke lengths.

Take the bumps and jumps out of air cylinder operation—install VERI-TROL checking cylinders wherever you want smooth, accurately-controlled stroke speed. Write now for free data bulletin; please address Dept 86.

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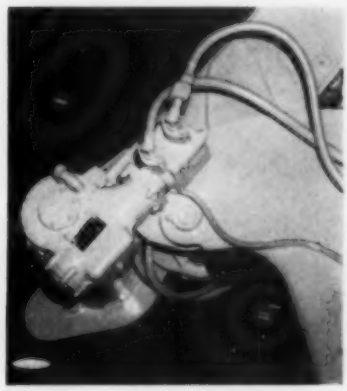
Circle **79** *on Time-Saver Card*

BRIEFS

HANDLING MATERIAL HANDLING —Because their equipment was too big to drive into Cleveland's Public Hall. Dempster displayed these

working models. Making miniature cylinders and connections taught them some new tricks about hydraulic design.



CRANE WINCH DRIVE—A vane motor drives through a 50:1 worm gear to wind up cable on Austin Western's crane. Cable speed is 70 fpm, load capacity is 24,000 lb. 1200-psi pressure on the motor does the job.

Remote Control Of Air Motors

A new system of remote control of its air motors has been announced by Holman Brothers Ltd., Camborne, England. The new control allows single or multiple motors to be controlled for forward, neutral, or reverse operation from distances to 200 feet.

A duplex piston assembly actuates a rack and pinion, positioning the reversing valve of the motor. A lever operated valve on

Continued on page 40

Jet brake cup — LS-53
Synthetic lube diaphragm — LS-53
Diesel equipment seal — Viton
Drop-off tank seal — LS-53
Chemical pump liner — Viton
Natural gas valve diaphragm — Viton

For advanced fuel...hydraulic...lube systems,

New materials prove ideal in handling temperature extremes −350° F. to +750° F.

Working with two remarkably versatile elastomers, C/R Sirvene engineers are producing flexible molded parts for many vital fuel, lubricating, hydraulic and pneumatic systems. One, Viton-A*, can be compounded to produce parts that function dependably at 600° F., and for short periods up to 750° F. The other important feature of Viton compounds is their excellent resistance to corrosive chemicals, chlorinated solvents as well as both synthetic and petroleum base fuels and lubes. At the other extreme, C/R compounded Silastic LS-53** parts are providing low temperature operation down to -80° F. They also exhibit excellent resistance to synthetic and petroleum base fluids up to 350° F., and function well in propane up to 500° F. For temperatures as low as -350° F., C/R recommends Teflon* compounds.

C/R Sirvene engineers have an intimate knowledge of these elastomers. They also have perfected special techniques in processing which still further improve the physical properties of the molded parts. If your problem involves high or low temperatures, close tolerances, and compatibility in advanced design fuel, lubricant or hydraulic systems, get in touch with us at once. We have the skill and the facilities to help you.

* DuPont registered trademark
**Dow-Corning registered trademark

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QUALITY THAT PRODUCES TOP PERFORMANCE

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HEAT EXCHANGERS

- Flanged baffles . . . pioneered by YA eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2″ through 10″ diameters.
- Now available from stock.
- Ask for Bulletin HT-1A.

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Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

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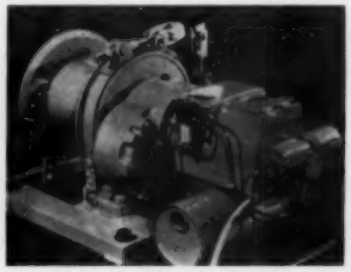
BRIEFS

the control panel directs air to the assembly.

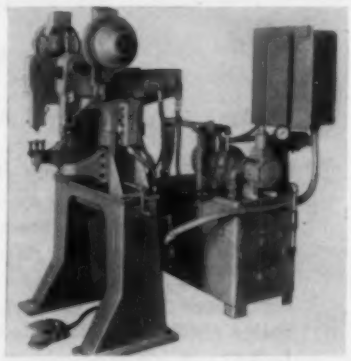
In the neutral position air is admitted to both sides of the pistons, centralizing rack and pinion so the reversing valve cuts air power to the motor.

Pressure released from the piston moves rack and pinion ac-



cordingly, admitting pressure air to the required ports of the motor to drive it either forward or in reverse.

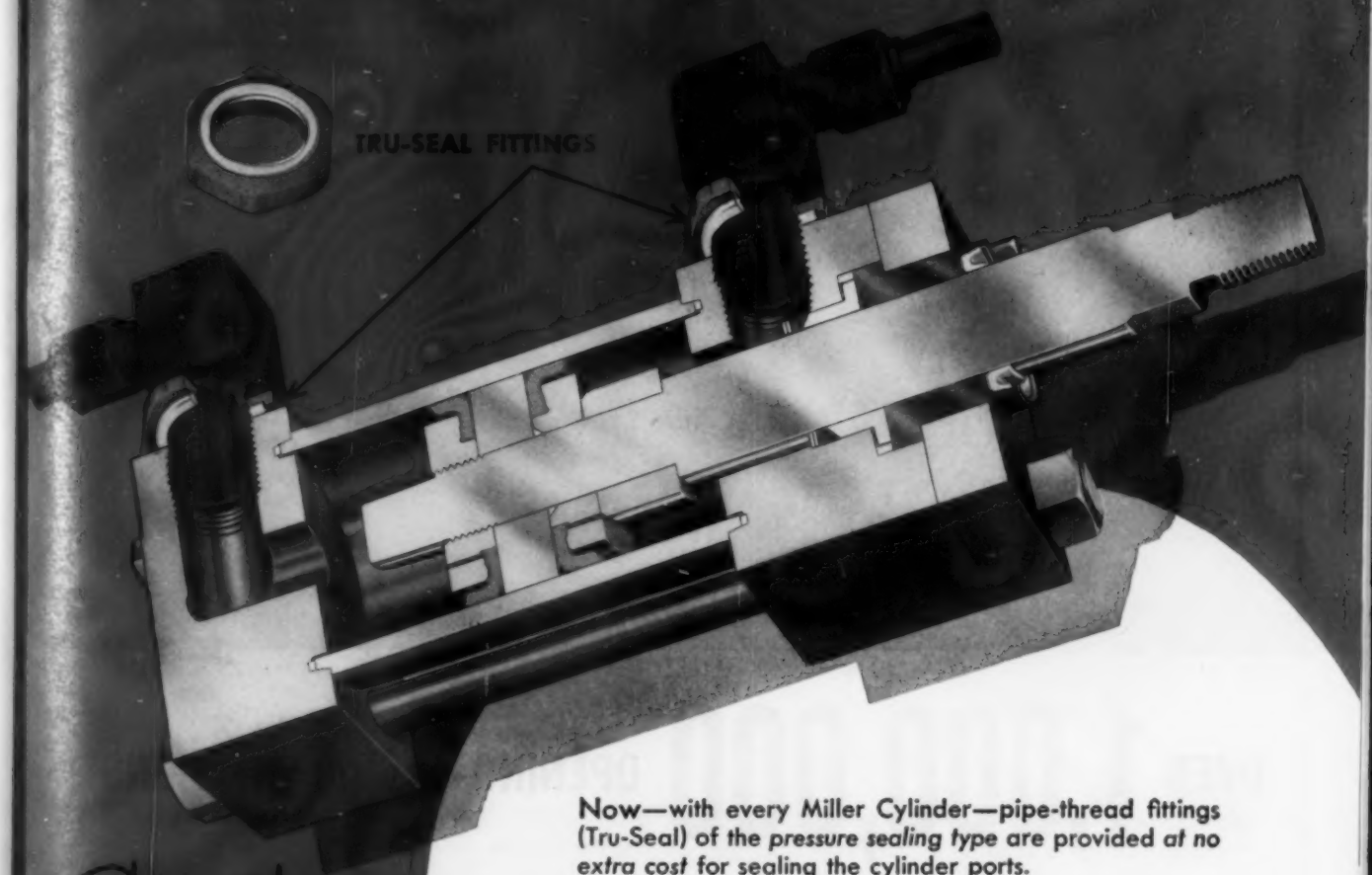
This control valve can be operated by hand or push button. Two sizes are available—$\frac{5}{16}$″ for distances to 40′ or $\frac{1}{2}$″ for more remote installations. □□□



A DUAL RIVETER has been introduced using hydraulic power and adaptable to a wide range of set-up requirements. Complete with all hydraulic and electrical equipment and controls, the Model HDR is used to speed up production line or unit machine riveting jobs. Tooled to utilize and set two ¼″-dia. solid steel rivets that are gravity fed from two 10″ hoppers, the operating cycle is approximately .8 sec. at 420 psi oil pressure. Maximum operating pressure is 1000 psi. Manufacturers are Tomkins-Johnson, Jackson, Mich.

NOW... even the PORTS have seals of the PRESSURE SEALING TYPE!

(J.I.C. Standard H6.2.2)



Now—with every Miller Cylinder—pipe-thread fittings (Tru-Seal) of the *pressure sealing type* are provided *at no extra cost* for sealing the cylinder ports.

Additional advantages of these fittings are:

1. All circuit piping and fittings can be easily positioned.
2. Damage to equipment caused by high tightening torque is completely eliminated (especially on valves, pumps, etc.)
3. Sealing material is Teflon, which is compatible with all hydraulic fluids (J. I. C. Standard H6.2.1)

Specify **Miller** for Greater Reliability

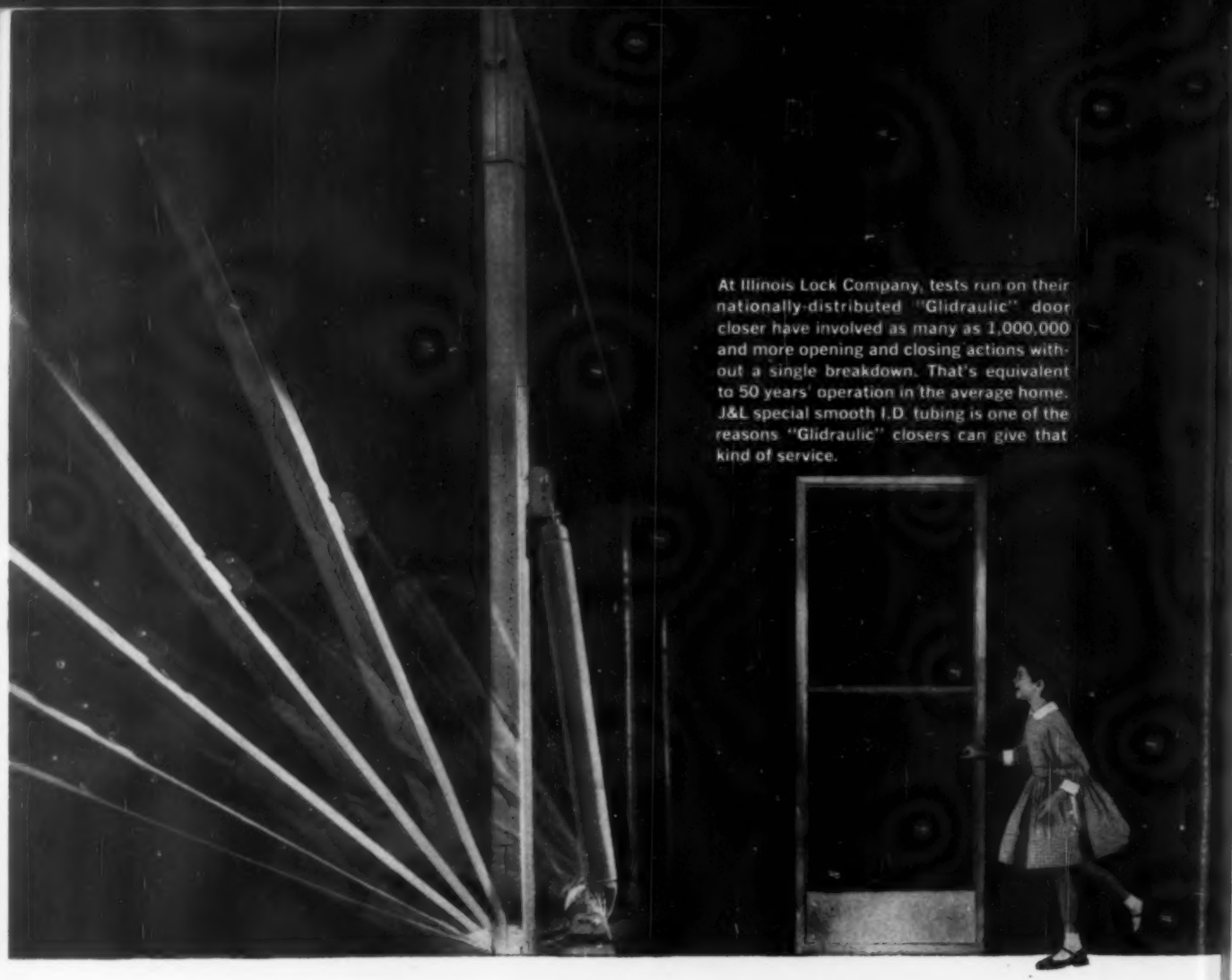
Engineering Bulletins on Miller Air and Hydraulic Cylinders Available on Request

MILLER FLUID POWER

DIVISION OF BUCK-BERRY CORPORATION

7N017 YORK RD., BENSENVILLE, ILLINOIS

AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS



At Illinois Lock Company, tests run on their nationally-distributed "Glidraulic" door closer have involved as many as 1,000,000 and more opening and closing actions without a single breakdown. That's equivalent to 50 years' operation in the average home. J&L special smooth I.D. tubing is one of the reasons "Glidraulic" closers can give that kind of service.

OVER 1,000,000 OPENING-CLOSING ACTIONS

of "Glidraulic" door closer prove quality of J&L Electricweld cylinder tubing

"The consistently high quality of J&L special smooth I.D. tubing is a must for us because we guarantee our sealed hydraulic door closers for 15 years," says Stanley Wolniak, product engineer of the Illinois Lock Company, Chicago, Ill. J&L tubing has to be rugged to take continuous operation like this *without failure of any kind.*

"The excellent inside finish of J&L Electricweld cylinder tubing requires no machining and prevents wear due to piston travel," Mr. Wolniak adds. "Its great wall strength resists bending under heavy pressure. And because of the uniform true diameter of J&L special smooth I.D. tubing, we don't have to pay the added cost for restricted tolerance tubing.

"As our door closers use hydraulic action, the cylinder tubing must meet critical requirements. For our purposes, J&L electric-resistance-welded tubing is the finest available."

Illinois Lock Company purchases J&L Electricweld tubing in ready-to-use 12" lengths, deburred at the mill. No inside honing or other cylinder machining operations are necessary.

J&L STEEL

Jones & Laughlin Steel Corporation

ELECTRICWELD TUBE DIVISION
PITTSBURGH, PA.

Circle **65** *on Time-Saver Card*

. . . a unique combination

Houghton is the only manufacturer who can offer you a complete choice of packings and a complete choice of fluids to meet every industrial hydraulic requirement.

To work together, efficiently and safely, packings and fluids must be compatible and well-engineered. And no one is better qualified to tell you which packing will work best with any particular type of fluid—than the manufacturer who designs, formulates and produces all types of both. (It's also your guarantee of a completely unbiased recommendation.)

Take advantage of this unique background and experience in both hydraulic packings *and* fluids by calling your Houghton Man today—or write: E. F. Houghton & Co., 303 W. Lehigh Ave., Phila. 33, Pa.

VIM Leather and VIX-SYN Rubber PACKINGS
HOUGHTO-SAFE and HYDRO-DRIVE FLUIDS

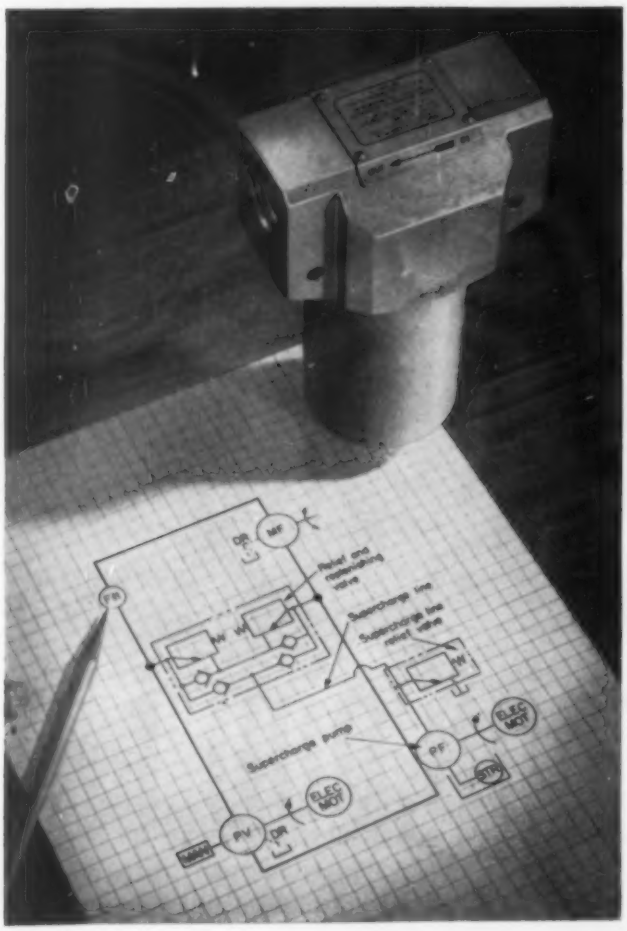
. . . *products of*

E. F. HOUGHTON & CO.

Ready to give you on-the-job service

Philadelphia, Pa. • Chicago, Ill. • Carrollton, Ga. Detroit, Mich. • San Francisco, Calif. • Toronto, Canada

Filters put performance into this adjustable-speed hydraulic transmission circuit



For applications requiring any combination of torque and horsepower characteristics, an adjustable-speed hydraulic transmission consisting of a variable-delivery pump and variable-displacement fluid motor is generally used. In a reversing adjustable-speed hydraulic transmission circuit, either pump line may be the intake side. This type of transmission can be used to advantage in applications requiring a wide speed range. Over-all efficiency for this type of hydraulic transmission is approximately 85 per cent for all output speeds greater than 30 per cent of maximum.

In development of variable-speed transmission circuits, the rules and factors governing the design of hydraulic circuits in general apply. Protection of hydraulic fluid from contamination is essential for dependable performance of the circuit. And Purolator filters provide the most effective protection available today. The unit shown (PR-412-8) is used in many circuits like that above. It has military approval for 3000 psi service. It is part of a series offering a range in nominal rated capacity from ½ to 12 gallons per minute. Differing in relief valve design, the more recent types comply with MIL-F-5504A. The case can be unscrewed and removed for replacement of the element without disturbance to connections. To improve your hydraulic system, get precisely the filter you need by contacting Purolator.

THIS CIRCUIT incorporates a supercharge pump and a reversible replenishing system. Supercharging increases capacity of the main pump by maintaining pressure at the pump inlet and removing the possibility of cavitation at high flow rates. The supercharge pump has its own relief valve which limits inlet pressure to the main pump to approximately 150 psi. The relief and replenishing valve is a single unit which because of the arrangement of the check valves admits fluid to the system on the low-pressure side of the main pump but does not permit fluid pressure to be lost from the high-pressure side despite flow reversal.

Filtration For Every Known Fluid

PUROLATOR

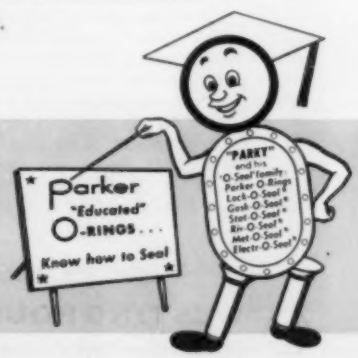
PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

WHEN IT COMES TO SEALING— IT'S A FACT THAT . . .

seal better and last longer in actual use!

Perhaps you can't **SEE** the difference or **FEEL** the difference, but comparison tests prove that Parker-O-Rings are **better.** Exhaustive research, experimentation and development, **plus** uncompromising standards of manufacture assure consistent accuracy of both materials and dimensions. So when you need O-rings, be **SURE** — specify **PARKER.** Most sizes are carried in stock ready for immediate delivery.



Parker SEAL COMPANY

CULVER CITY, CALIFORNIA and CLEVELAND, OHIO
A DIVISION OF PARKER-HANNIFIN CORPORATION

Typical Control Functions solved by **AIR CIRCUITRY**

Westinghouse Multi-Position Cylinder

The Westinghouse Air Brake Company's complete line of AIR CIRCUITRY components contains a wide variety of pneumatic positioners to handle almost all of your force and positioning requirements.

No longer is pneumatic positioning limited to a single or double acting cylinder. Remotely controlled by directional and/or pressure control valves, both variable and fixed force and positioning is possible. Along with all the advantages of air, these devices are easily maintained and serviced. Uncomplicated and rugged, pneumatic positioners may be the answer to your control problems.

Typical Applications—The illustrated positioners have been used in almost every field of industry today. These positioners can:

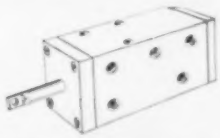
clamp	punch	knurl	convey	push
rotate	lock	form	bend	blank
index	broach	crimp	cushion	pull
hold	squeeze	twist	stretch	eject
feed	shear	raise	brake	move
pierce	lower	press	turn	coin

If you have a positioning problem, let us know about it. It can probably be solved with AIR CIRCUITRY. For more information, ask for our catalog on Positioners.

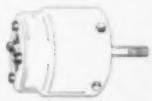
What is AIR CIRCUITRY?

This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise AIR CIRCUITRY is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will help you boost production and cut costs in your plant or shop.

1. ONE AND TWO STATION POSITIONING—Single and double acting cylinders can perform all types of force and positioning functions. The Westinghouse line of cylinders includes diameters from 1" to 10"; strokes to suit application; single and double end; foot, swivel, flange and trunnion mounts.

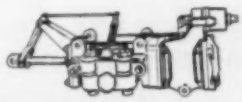


2. MULTI-STATION POSITIONING — Controlled by an associated directional valve, these cylinders attain 3, 4, 5 and 7 fixed positions of stroke. Three position cylinders are available in 2", 3", 4", 5" and 6" diameters. Strokes may be obtained to suit application.



3. VARIABLE FORCE AND POSITIONING — Diaphragm type cylinders are controlled by manually or mechanically operated pressure control valves to achieve a variable force or position of the rod. Various diaphragm areas and strokes available.

4. INFINITE POSITIONING-LIGHT—The actuator positioner has an infinite number of positions, governed by the amount of air pressure acting on its spring opposed diaphragm. Remotely operated pressure control valves dictate the position of the operated lever. This device has a low force rating.



5. INFINITE POSITIONING-HEAVY—The Westinghouse PNEUDYNE® Positioner can position accurately, independent of the opposing force, up to its power capacity. The power capacity is determined by piston size and supply pressure. Remotely controlled by pressure control valves, this device maintains its position throughout changes in the opposing force.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY

INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

Circle **122** *on Time-Saver Card*

FUTURE EVENTS

September 14-17: National Farm, Construction, and Industrial Machinery Meeting, Production Forum, and Display. Milwaukee Auditorium, Milwaukee, Wisc.

September 21-25: ISA 14th Annual Instrument-Automation Conference Exhibit, International Amphitheatre, Chicago, Ill.

October 5-10: SAE National Aeronautic Meeting Aircraft Manufacturing Forum, and Aircraft Engineering Display. The Ambassador, Los Angeles, Calif.

October 22-23: 15th Annual National Conference on Industrial Hydraulics, Hotel Sherman, Chicago, Ill.

October 26-28: Annual Fall Meeting, National Fluid Power Association, Statler Hotel, Detroit, Mich.

October 26-28: SAE National Transportation meeting, La Salle Hotel, Chicago, Ill.

October 28-30: SAE National Fuels and Lubricants meeting, La Salle Hotel, Chicago, Ill.

November 2-6: 41st National Metal Exposition & Congress, International Amphitheatre, Chicago, Ill.

November 16-20: ASME Automation Show & Conference on Material Handling, Trade Show Building, New York, N. Y.

December 11: Association of Lift Truck & Portable Elevator Manufacturers, Roosevelt Hotel, New York, N. Y.

This is an actual photograph of 1½" Springfield "400" hose.

NOW!

design with large diameter

Teflon* hose that bends like this!

6¾"

If you design fluid handling, transfer, or hydraulic equipment, you already know Teflon hose. Wonderful! Except, up to this time larger diameters were not really flexible. But *now* look!

SPRINGFIELD "400" WITH FINGER FLEXIBILITY ONLY TITEFLEX HAS IT!

- Minimum bend radius: *only 3⅓ times the hose diameter!* Thanks to the exclusive TITEFLEX process.
- Teflon innercore with all its properties. It's tough, lightweight, inert, resistant to corrosion and temperature extremes. Flex life is almost endless.
- Available now up to 2" in diameter, lengths to 25 feet (soon to 50!).
- Fittings prove failure-proof—right up to burst pressure of hose!
- In many cases, a shorter Springfield "400" hose can replace extruded hose at big savings.

Springfield "400" has already made exciting news in scores of applications—new uses crop up every day. How about your field? Our bulletin will set design ideas clicking. Ask your TITEFLEX distributor (see the Yellow Pages) for a copy. Or drop us a line direct.

titeflex

Do these Springfield "400" applications suggest anything to you?

TANK, CAR, BARGE, MILITARY VEHICLE application • CHEMICAL • HIGH TEMPERATURE AIR • PLASTIC COMPOUND • HOT TAR AND ASPHALT • LIVE STEAM • CORROSIVE FLUID • HIGH TEMPERATURE HYDRAULIC SYSTEMS • AIRCRAFT: high temperature fuel and lubricating systems • MISSILE: fuel and oxidizer lines of vehicles and ground support •

titeflex inc. springfield mass. PACIFIC DIVISION • SANTA MONICA • CALIFORNIA

*Teflon is a duPont trademark
**T.M. of Titeflex, Inc., Pat. Pending

National O-Rings are precision made, uniform commercial rings available throughout the United States—promptly! Quality is superior; all ingredients are inspected before compounding and compounding is strictly controlled for maximum uniformity. Molding is done on modern equipment by veterans of 20 years in O-Ring manufacture. Every precaution is taken to insure that no O-Rings with cuts, scratches or mold defects are shipped.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California
Plants: Van Wert, Ohio, Redwood City and Downey, California

Atlanta 8, Georgia
George W. Smith Company
394 Williams St., N.W.
JAckson 3-7140

Chicago (Oak Park) Illinois
7001 North Avenue
Village 8-4500

Cleveland 18, Ohio
210 Heights Rockefeller Bldg.
3091 Mayfield Road at Lee
YEllowstone 2-2720

Dallas 19, Texas
Benson Engineering Company
2514 West Mockingbird Lane
FLeetwood 2-7541

Detroit 27, Michigan
13836 Puritan Avenue
VErmont 6-1909

Indianapolis 5, Indiana
2802 N. Delaware St.
WAlnut 3-1535

Kansas City (Prairie Village) Kansas
Benson Engineering Co.
2902 West 72nd Terrace
ENdicott 2-2843

Los Angeles (Downey) California
11634 Patton Road
TOpaz 2-8163

Milwaukee 4, Wisconsin
647 W. Virginia Street
BRoadway 1-3234

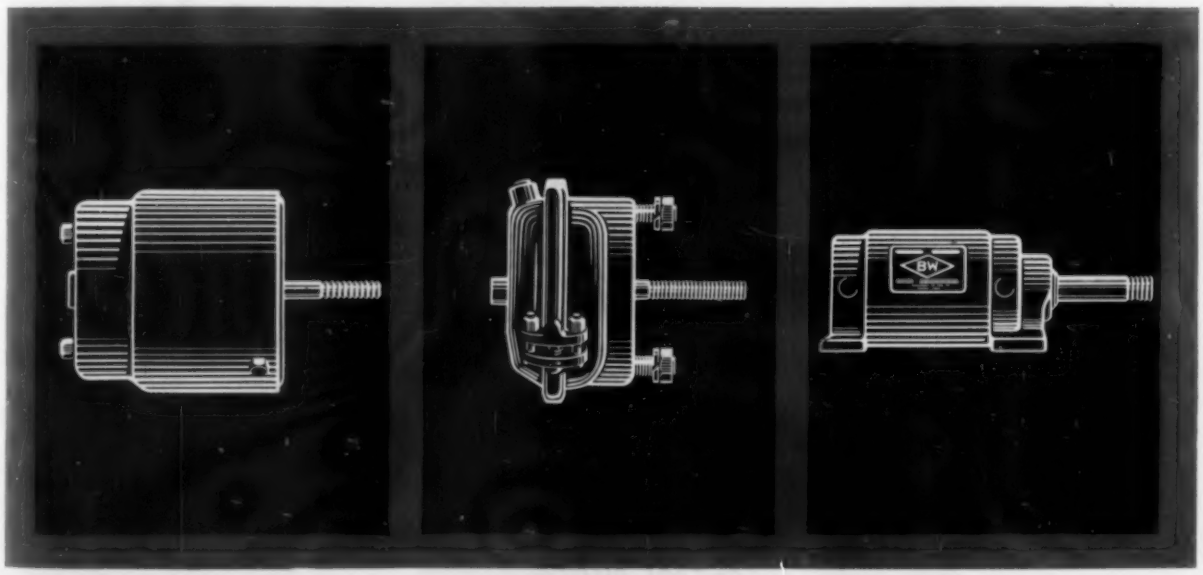
Red Bank, New Jersey
16 Spring Street
SHadyside 7-3242

Wichita, Kansas
Benson Engineering Company
519 So. Broadway
AMhurst 2-6971

8800

DEPENDABLE POWER CYLINDERS FOR EVERY APPLICATION

It will pay you to investigate the complete line of Bendix-Westinghouse air and hydraulic cylinders. Whatever your requirements, you'll find that Bendix-Westinghouse can fill *every* industrial application for precise, dependable, long-life air or hydraulic controls. Our substantial inventory of standard cylinders assures prompt delivery. Should you require equipment for a special application, we can custom-build power cylinders tailored to your individual specifications. And they're all backed by the Bendix-Westinghouse name—your solid guarantee of high quality and complete satisfaction. Write today for full information on how Bendix-Westinghouse industrial controls can make your job easier and save you money.



ROTOCHAMBERS. Frictionless. Leakproof. Neoprene diaphragm has a rolling action and exceptionally long life. Chrome molybdenum steel push rod. Available nine sizes delivering from 900 to 5000 pounds force at 100 psi air pressure.

ROBOTAIR CHAMBERS. Small overall diameter. No lubrication or filtering required. High grade steel stamping. Rubber diaphragm has flexing action. Leakproof. Available nine sizes delivering from 300 to 3600 pounds force at 100 psi air pressure.

POWER CYLINDERS. Piston-type air and hydraulic. Heavy wall steel tubing, precision honed. Head and mount are integral castings. High-tensile, heavily chromed rod with metal rod scraper. Available in all mountings and sizes.

Bendix-Westinghouse

BW

INDUSTRIAL PRODUCTS

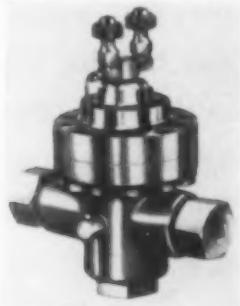
Bendix-Westinghouse Automotive Air Brake Company, Elyria, Ohio

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

HIGH PRESSURE REGULATORS . . . to 6000 psi

Designation: GD100, GD200 Series

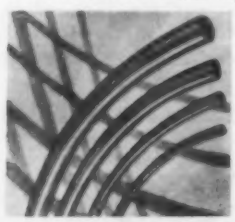


Features: For high flow regulation of fluids. Both series operate at maximum inlet and outlet pressures to 6000 psi, proof pressure to 12,000, and operating temperature range of −67 to +250 F.

Specifications: GD100 has valve, orifice sizes from ⅜-¾", with AN tubing or pipe connections. Maximum flow is 20,000 scfm. GD200 series has 1½" orifice, compensated to provide constant outlet pressure as inlet pressure decays. Connections either 1500-lb. ASA flanges for 3600 psi applications, or 2500-lb. ASA flanges for 6000 psi. Maximum flow is 50,000scfm.

Victor Equipment Co.
San Francisco, Calif.
Circle **300** *on Time-Saver Card*

FLEXIBLE AIR HOSE . . . unaffected by oil



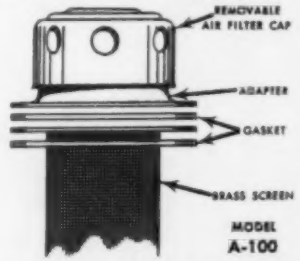
Features: Will not collapse under vacuum, abrasion resistant, unaffected by most corrosive atmospheres. Made of polyvinyl plastic. For continuous or intermittent use.

Specifications: In 100' lengths, brilliant red color. The ½" ID size carries 350 cfm at 125 psi. Accepts most tube fittings.

Munray Products, Inc.
Division Fanner Mfg. Co.
Cleveland, Ohio
Circle **301** *on Time-Saver Card*

FILLER BREATHER CAP . . . does threefold job

Features: Heavy duty, low cost. For all hydraulic power units. Gas-



kets for all mating parts. Performs functions of breathing, air filtering, and straining hydraulic oil as added.

Paul-Monroe Co.
Bell Gardens, Calif.
Circle **302** *on Time-Saver Card*

CONTROL PILOT . . . is easily adjusted

Features: Liquid level pilot with adjustable proportional band. Single knob controls adjustment while liquid level system is in operation without affecting level set point. Unaffected by surface turbulence and does not require floats, cages, linkages, torque tubes, or stuffing boxes, due to differential pressure sensing method.

Leslie Co.
Lyndhurst, N. J.
Circle **303** *on Time-Saver Card*

INDICATING RELIEF VALVE . . . for settings to 100 psi

Designation: Demi Tattle-Tale

Features: Offers continued indication of operation even after pressure has returned to normal. Fea-

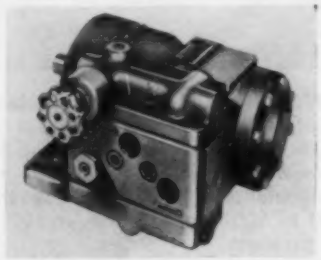
tures red anodized indicating pin which pops out instantly as valve opens. Pin remains in position until manually reset.

Specifications: Pressure adjustment screw on bonnet top can be furnished for settings from 3-100 psi. Available with NPT connections from 1/16-½" plus several tube and fitting sizes. Any barstock body material furnished to specification.

George W. Dahl Co., Inc.
Bristol, R. I.
Circle **304** *on Time-Saver Card*

TWO-VOLUME PUMP . . . has fast response

Features: Prevents excessive heat



and wasted hp by automatically maintaining system pressure with small volume pump. A fixed differential between relief valve setting and unloading valve allows return of large volume pump ca-

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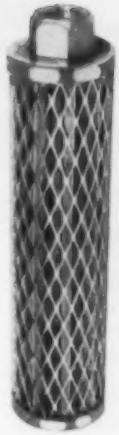


Tandem Synclinal SUMP TYPE

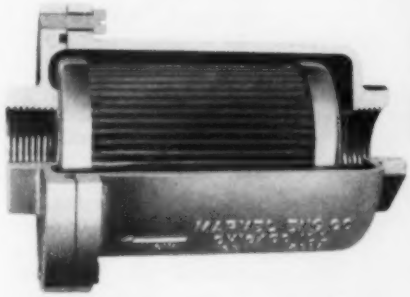
CAPACITIES: 10—16—20—40—60—100—150 and 200 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Bonded SUMP TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1¼"—1½"—2"—and 2½".
CONNECTIONS: Coupling—"O" Ring—Male Nipple.
BY-PASS VALVE: Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.



IN-LINE FILTER

CAPACITIES: Up to 60 G.P.M.
PIPE SIZES: ¾"—1"—1¼" and 1½" (at both inlet and outlet).
BY-PASS VALVE: Available with or without By-Pass Valve.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants and all types of Fire-resistant Hydraulic Fluids.

MARVEL
SYNCLINAL FILTERS

FOR DEPENDABLE PROTECTION on all Hydraulic and other low pressure circulating systems

MARVEL FILTERS are designed to give more ACTIVE filtering area—MORE dependable protection—MORE productive operation before filter cleaning is necessary. *They meet J. I. C. Standards.*

FILTERING MEDIA in all Marvel Filters is Monel wire cloth and available in mesh sizes of 30-40-50-60-80-100-150 and 200 to meet your degree of filtration requirement.

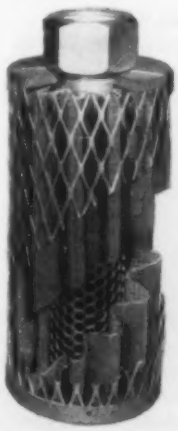
EASY TO CLEAN—All Marvel Filters are easy to clean. Line type units operate in any position and may be serviced without disturbing pipe connections.

OVER 900 Original Equipment Manufacturers install Marvel Filters as Standard Equipment.

IMMEDIATE DELIVERY

For further information on a specific type or size filter—Write—wire or phone

MARVEL ENGINEERING COMPANY
7227 N. Hamlin Ave., Chicago 45, Illinois • Phone: JUniper 8-6023



Synclinal SUMP TYPE

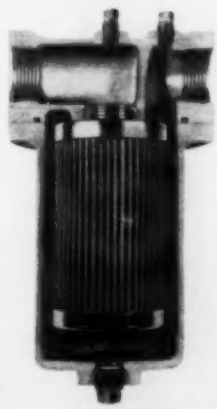
CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
CONNECTIONS: Coupling—Male Nipple.
BY-PASS VALVE: Not Available.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.

Synclinal LINE TYPE

CAPACITIES: 5—8—10—20—30—50—75 and 100 G.P.M.
PIPE SIZES: ¾"—1"—1¼"—1½"—2"—2½" and 3".
BY-PASS VALVE: Not available.
OPERATING PRESSURES: Up to 80 p.s.i.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids and Water.



Bonded LINE TYPE

CAPACITIES: 10—20—30—50 and 75 G.P.M.
PIPE SIZES: 1"—1¼"—1½"—2" and 2½".
BY-PASS VALVE: Available with or without.
OPERATING PRESSURE: Up to 250 p.s.i.
OPERATING TEMPERATURES up to 300° F.

For use with regular petroleum base Hydraulic Oils, Coolants, Lubricants, all types of Fire-resistant Hydraulic Fluids.

Portable Hydraulic Power Pumps
10,000 psi intermittent
6,000 psi continuous

No. 797-E-SA

No. 797 series
213 cu in. per min. at 10,000 psi

Extra-high-speed drive at high pressure. Applies to a wide range of hydraulic systems. Compact unit . . . pump reservoir, and control valve in one housing. Simply operated, 2-position control handle with advance and return positions. Available with 4-way valve for double-acting rams. Delivers 213 cu in. of oil per min at 10,000 psi with 3 hp a-c motor . . . 106 cu in. with 2 hp motor.

No. 797-G-SA is same pump powered with 4½ hp 4-cycle, air-cooled gasoline engine.

No. 798 series
28 cu in. per min.
. . . at 10,000 psi

Easily carried, high-pressure pump. Has exclusive fast approach . . . high volume, low pressure . . . automatic change-over to low-volume, high-pressure drive. Develops 6,000 psi continuous pressure, 10,000 psi intermittent. Choice of integral 2-way or 4-way valve. Built-in 115 - 230 V ¾ hp a-c motor. Also available with built-in 1.7 hp gasoline engine, universal or low-voltage motor. Write for illustrated data sheets.

ALSO A SELECTION OF HYDRAULIC HAND PUMPS AND VALVES

GREENLEE TOOL CO.
1775 Columbia Avenue
Rockford, Illinois

GREENLEE

Circle **31** *on Time-Saver Card*

NEW PRODUCTS

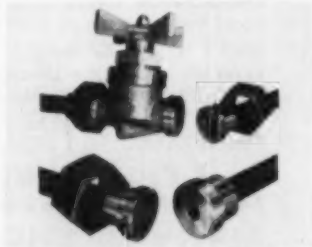
pacity to reservoir at low pressure. Unloading response with single setting is three times faster than previous two-adjustment models. Exceptional pressure recovery.

Specifications: For 1000 psi at 1200 rpm for small volume; 750 psi at 1200 rpm for large volume. One pump group has 18 combinations of small pump cartridges with operating pressure capacities of 4 to 21.4 gpm. Second group has 30 combinations with capacities of 14.7 to 45.2 gpm. Choice of foot or flange mountings available.

Vickers Incorporated
Detroit, Mich.
Circle **305** *on Time-Saver Card*

O-RING VALVES, FITTINGS
. . . eliminate connection leaks

Features: Line includes globe, angle, and relief valves, check valves, nuts, tailpieces, threaded pieces, adapters, plugs, and reducing inserts. System easily installed or removed without springing or cutting line. Tailpieces, threaded pieces available for socket welded, brazed or pipe-threaded attachment to line. Connection leaks eliminated.



Specifications: All parts for pressures to 5000 psi, temperature range from −20 to +275 F.

Combination Pump Valve Co.
Philadelphia, Pa.
Circle **306** *on Time-Saver Card*

90° SWIVEL CONNECTOR
. . . eliminates hose flexing

Features: Capable of delivering hydraulic fluid at any angle under adequate pressure, eliminating hose flexing. Connector absorbs part of swing, cutting hose allowance for complete extension of moving part. Low torque operation, friction-free. Interior design provides balanced fluid flow, causing body to float around stem, free of any end load or friction. Pressure absorbed equally by double seal at each end of stem.

Specifications: Ends available include male pipe, hydraulic male, O-ring male, plus solid and swivel female. Sizes from ½-1½". Machined or bar steel, plated for corrosion protection. Operation to 5000 psi.

Eastman Mfg. Co.
Manitowoc, Wis.
Circle **307** *on Time-Saver Card*

MAGNETIC PLUG
. . . meets JIC standards

Designation: Tank-Trapper

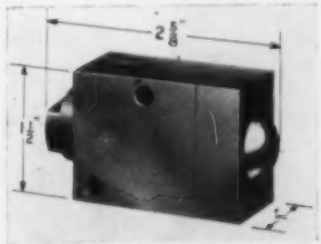
Features: Removes ferrous particles from hydraulic equipment reservoirs. Easily removed for cleaning with compressed air. Units fit through 2" pipe flange opening, can be attached to a standard pipe plug. May be fastened to cover any opening larger than 2¼".

Specifications: In eight sizes from single-unit 10 gals. to multi-unit 350 gals. Four-unit offers effective area of 60 sq. in.

The Kebby Co.
Rockford, Ill.
Circle **308** *on Time-Saver Card*

BALL CAM VALVE
. . . is 2-way

Features: Corrosion-proof valve with single poppet element operated by stainless-steel ball cam. Other exposed parts are anodized aluminum. Immediate delivery.



Specifications: Measures 2⅝x1½x 1" and can be mounted in any position.

Airmatic Valve, Inc.
Cleveland, Ohio
Circle **309** *on Time-Saver Card*

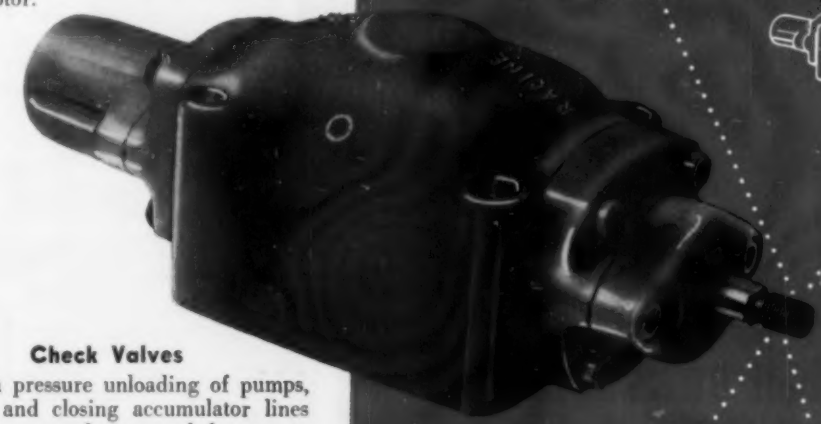
Continued on page 54

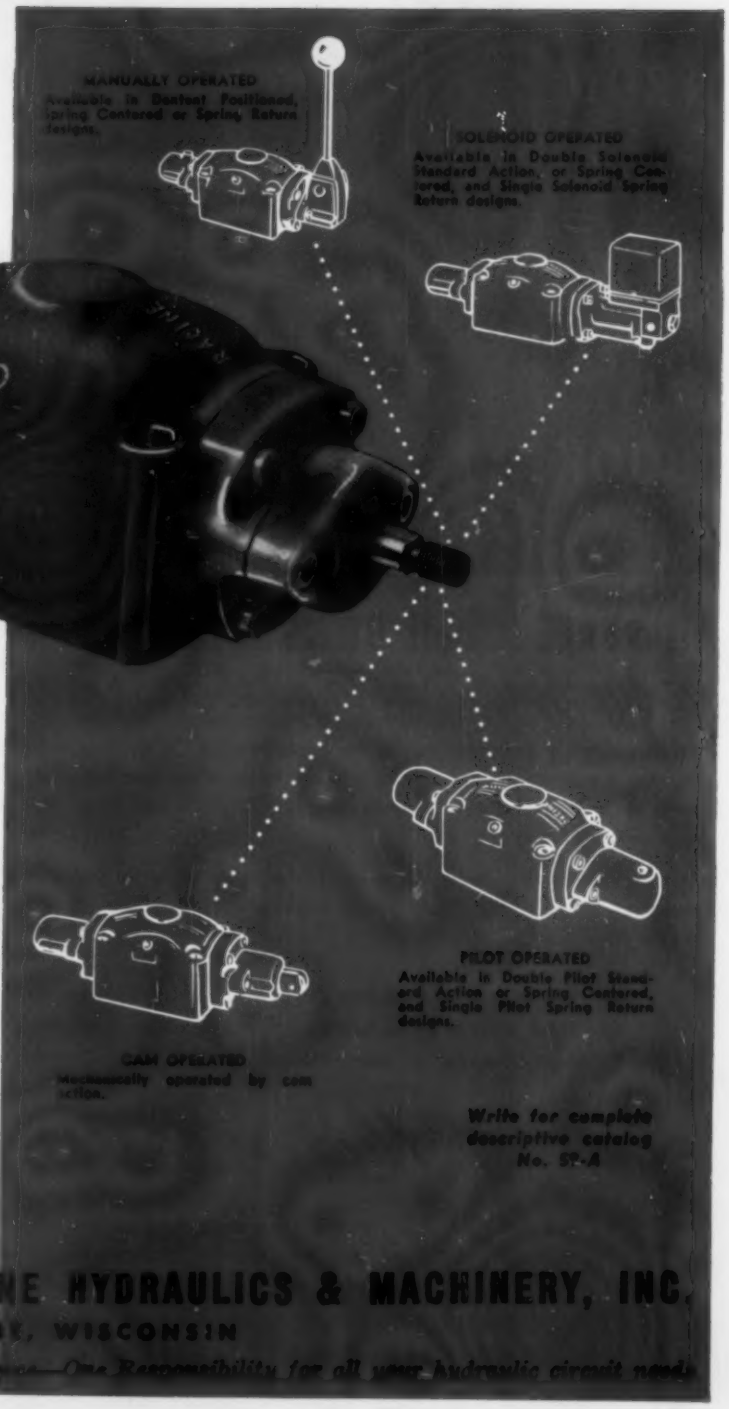
RACINE-SECO

Hydraulic Valves

DIRECTIONAL CONTROL VALVES
Valves 4-way and 2-way

Designed to conform with J.I.C. specifications. All sizes 3/8" to 2" — foot or sub-plate mounted, with neutral porting arrangements to suit your needs. Pressure rated up to 1500 psi. Sleeve type construction permits controlled acceleration or deceleration of a cylinder or fluid motor.

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Available in Detent Positioned, Spring Centered or Spring Return designs.
SOLENOID OPERATED
Available in Double Solenoid Standard Action, or Spring Centered, and Single Solenoid Spring Return designs.
PILOT OPERATED
Available in Double Pilot Standard Action or Spring Centered, and Single Pilot Spring Return designs.
CAM OPERATED
Mechanically operated by cam action.
Write for complete descriptive catalog No. 57-A

Check Valves

For high pressure unloading of pumps, opening and closing accumulator lines and when properly grouped for use as high pressure directional valves for 3-way or 4-way functions. Sizes 3/8" to 2" up to 10,000 psi. Design conforms with J.I.C. specifications.

VOLUME CONTROL VALVES

Pressure compensating and non-compensating types available. 1/4" to 2" sizes. Pressure compensating valves are ideal for Meter In, Meter Out or Bleed-Off control of accurate oil flow.
Non-compensating valves provide an adjustable flow rate by varying the adjustable orifice. Designed to J.I.C. standards.

PRESSURE CONTROL VALVES

A complete line including Relief, Sequence, Counterbalance, Resistance and Counterbalance and Pressure Reducing Hydraulic Valves. Sizes 3/8" to 1 1/4". 100 to 1500 psi pressure range.

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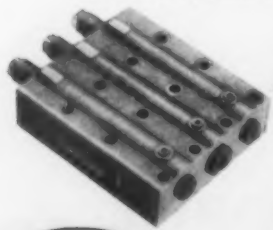

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FULFLO can engineer a special valve to your most exacting requirements. Examples of "specials" are shown in Data Book.

FULFLO **THE FULFLO SPECIALTIES CO., INC.**

415 Fancy Ave. Blanchester, Ohio

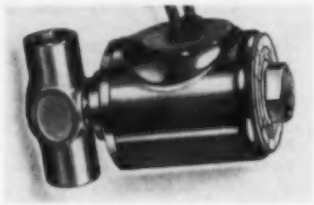
Circle **47** *on Time-Saver Card*

NEW PRODUCTS

SOLENOID VALVES
. . . have small ports

Designation: Series 90 and 95

Features: Miniature size, 2-and 3-way direct-acting valves. Have silver AC shading coils, fully rotatable coil housings for electrical connections from any angle, and operate in any mounted position and broad range of pipe and tube connections. Quiet operation.



Specifications: Brass or stainless steel bodies. Series 90, 2-way types orifice from 1/32-1/8", with differential ratings to 2000 psi. Series 95 3-way types from 1/32-1/16", ratings to 300 psi. Two-way types in NO and NC designs, 3-way types include Universal flow pattern for less critical use as either NO or NC. Windings designed to UL requirements for operating at 10% over, 15% under rated coil voltage.

Hoke, Inc.
Cresskill, N. J.
Circle **310** *on Time-Saver Card*

INTERNAL MICROMETER
. . . is accurate to .0005"

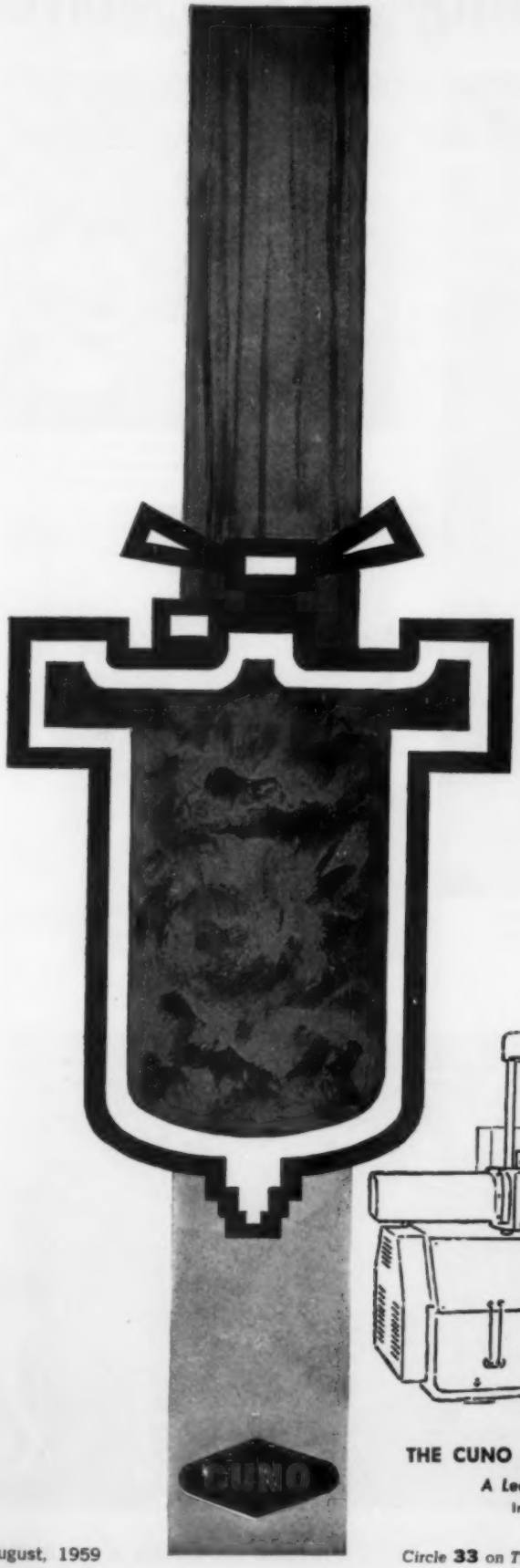
Designation: Multi-Mike

Features: Measures cylinder groove and land widths, O-ring widths, groove and keyway locations.

Specifications: Measurements accurate to .0005" possible from .050-1.050" for groove widths; 0-1.000" for lands and distances between grooves. Will locate from an external reference to probe depth of 5¾".

Navan Products, Inc.
El Segundo, Calif.
Circle **311** *on Time-Saver Card*

For more NEW PRODUCT reviews turn to page 114



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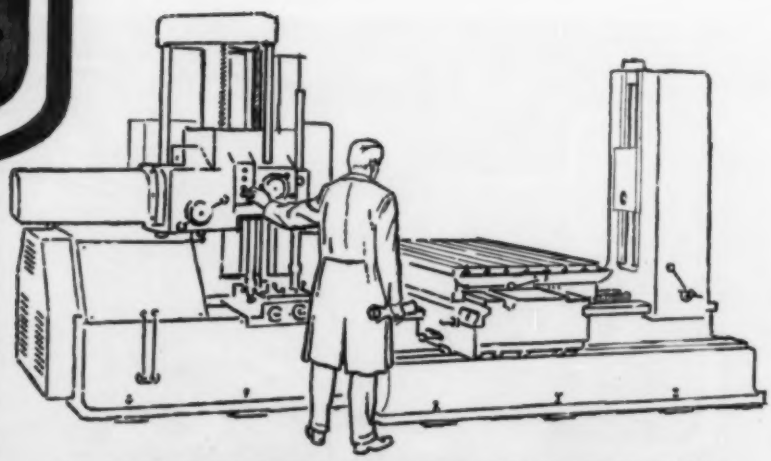

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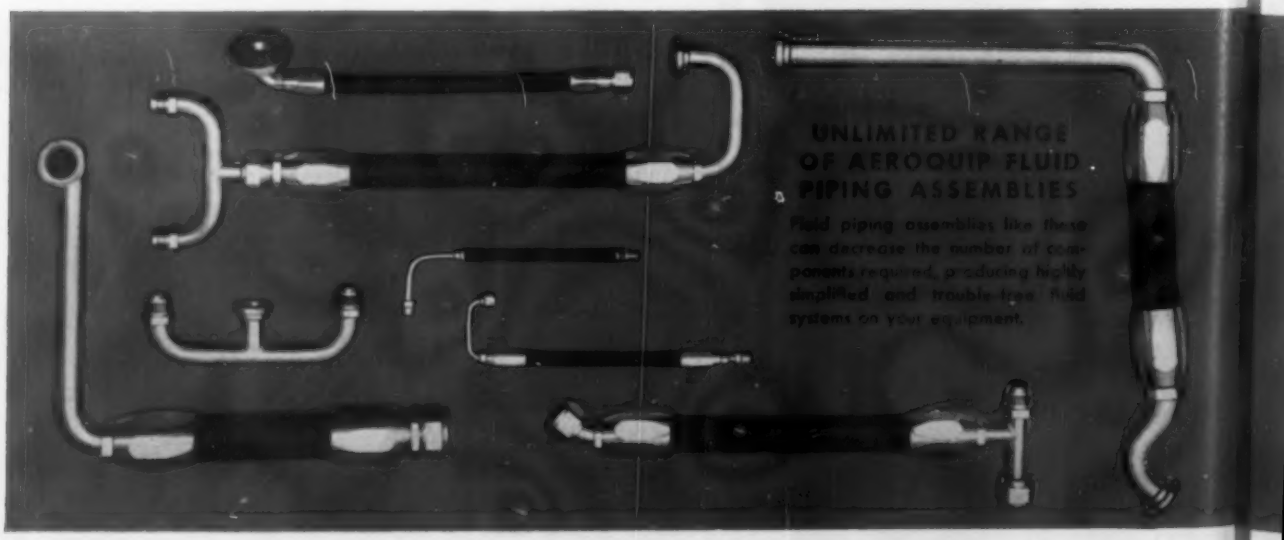

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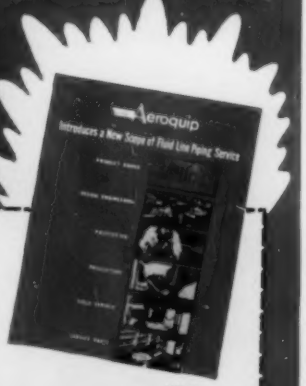

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Aeroquip Corporation, Jackson, Michigan

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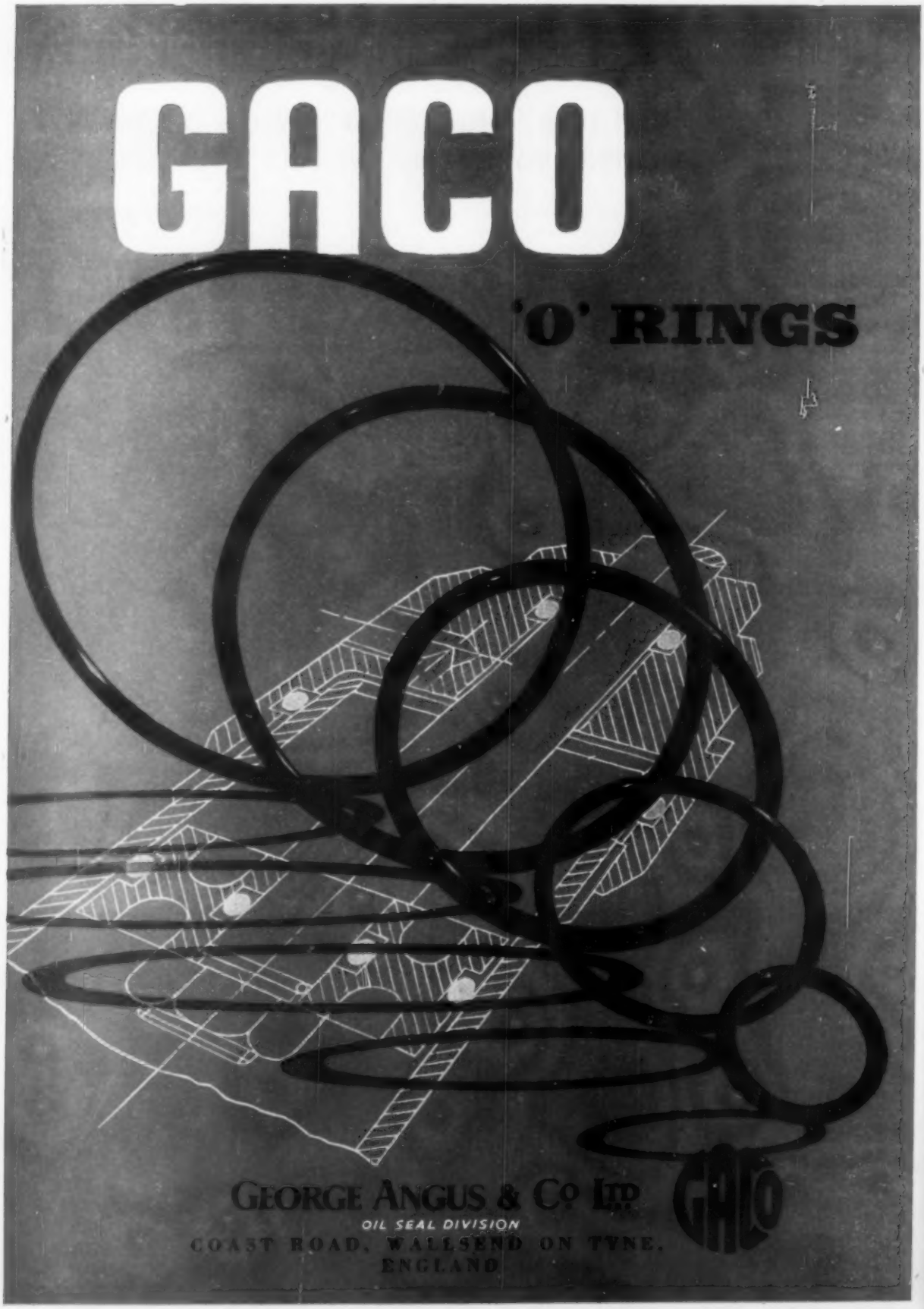
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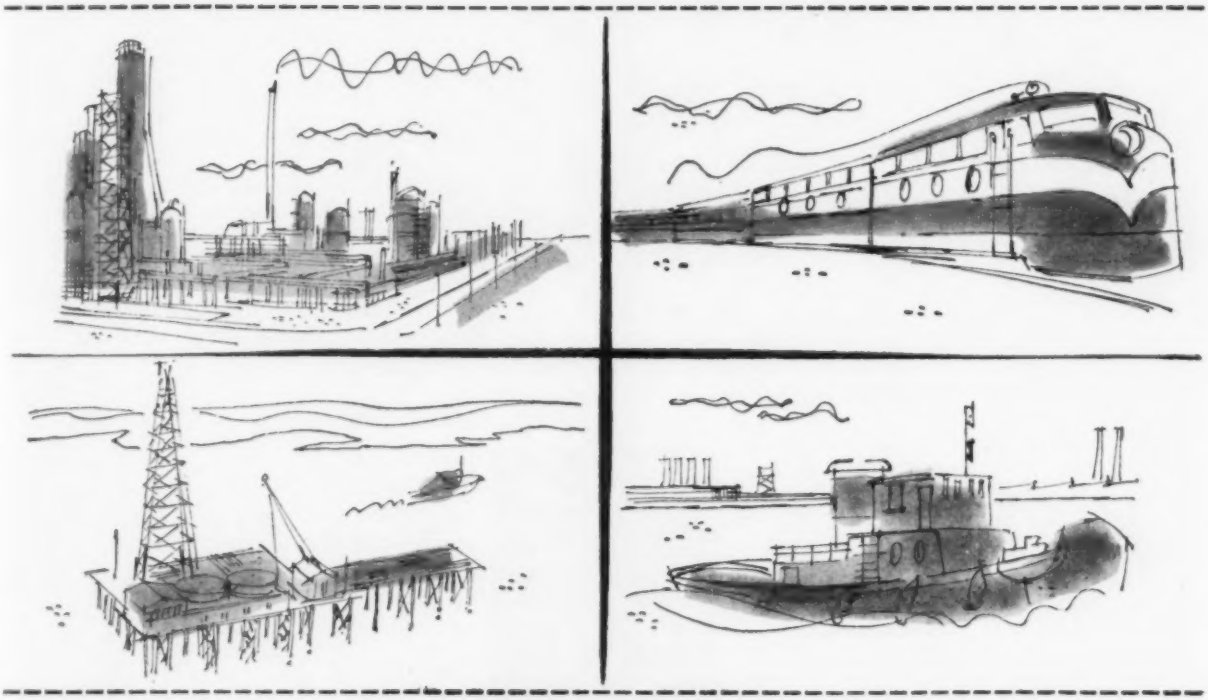

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NICKEL TUBING

Chemical composition, physical constants, and mechanical properties of "A" nickel, low carbon nickel, "D" nickel, and duranickel described in folder. Tubing is seamless. Tables list ODs from .012-1.125". General characteristics, typical uses given. No. CM-359. *Superior Tube Co., Norristown, Pa.*

Circle **400** on Time-Saver Card

FLUID FOR MINES

Consists of an inexpensive petroleum oil concentrate to be mixed with water immediately before use. Forms emulsion type fire resistant hydraulic fluid for many applications. Background, specifications, typical properties given in Technical Bulletin on 3XF Fluid. *Shell Oil Co., New York, N. Y.*

Circle **401** on Time-Saver Card

WELDING FITTINGS

And forged steel flanges in 1¼" nominal pipe sizes. Tables of descriptions, dimensions, weights. Drawings of all models, types. Technical Bulletin FDC-255. *The Babcock & Wilcox Co., Tubular Products Division, Welding Fittings Dept., Milwaukee.*

Circle **402** on Time-Saver Card

MOLDED CUPS

For pump pistons, hydraulic service, and pneumatic equipment. Details include construction, recommended service, and available sizes of rubber and synthetic rubber, leather, reinforced synthetic rubber, metal bonded, and metal reinforced, and homogeneous cups. Product photos, drawings. Tables illustrate variety of applications. Information given for conversion of pistons for use with pump cups. Bulletin AD-145. *The Garlock Packing Co., Palmyra, N. Y.*

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O-RING SELECTION

Discussed by outlining of physical and mechanical considera-

tions. Contains data and tables simplifying selection, installation, lubrication, and maintenance of seals. Also covers materials, machining, and finishes proven compatible with O-ring sealing. *Auburn Mfg. Co., Middletown, Conn.*

Circle **404** on Time-Saver Card

AIR HOSE

Complete specification data on universal air hose and special line of fittings. Bulletin 1. *Synflex Products Division, Samuel Moore & Co., Mantua, Ohio.*

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HYDRAULIC MASTER-SLAVE UNIT

Is easily installed for mechanical or hand operation. Gives positive 2-way action with power relative to load applied. Application diagrams for both master and slave units, with dimensions outlined on scale drawings. Instructions given for charging circuit. Panels show many stock items for actuator. *Armstrong Patents, Co., Ltd., Beverly, England.*

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CONDENSIFILTERS

Incorporate an internal trap. Combines condenser, separator, and filter. Both Models M-30T and M-100T described in Bulletin 4158. Descriptions, specifications, cross-sectional drawings, and photos. Four pages. *Hankison Corp., Canonsburg, Pa.*

Circle **407** on Time-Saver Card

PURIFIER LINE

Described in eight-page brochure. Complete catalog of purifiers, separators, mist extractors, and scrubbers. 13 types included with pressures to 15,000 psi. Product photos, tables, specifications, guarantees, code information, typical installation drawings given. *V. D. Anderson Co., Division of International Basic Economy Corp., Cleveland.*

Circle **408** on Time-Saver Card

THREE-PHASE MOTOR

For compressor applications. Motor is UL listed. Inherent protection for integral-hp for guarding against abnormal overheating conditions. Illustrated Flyer GEA-6932 includes product feature description, motor ratings, and connection diagrams. *General Electric Co., Schenectady.*

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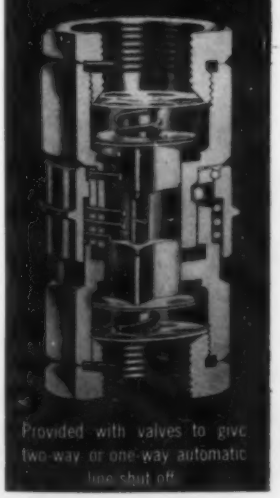
For more reviews of FREE LITERATURE turn to page 124



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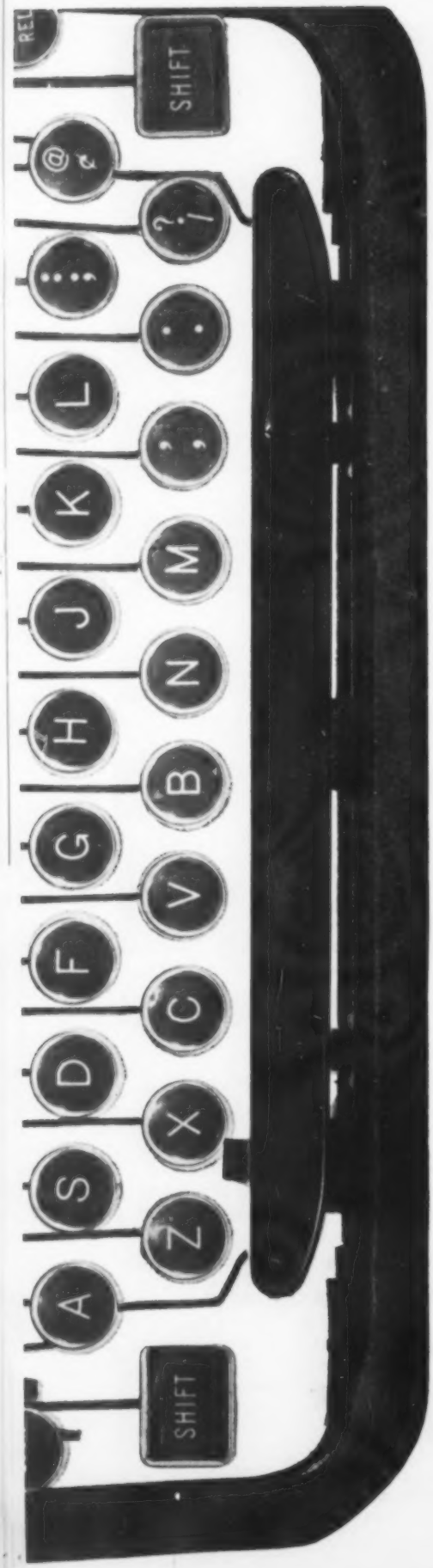

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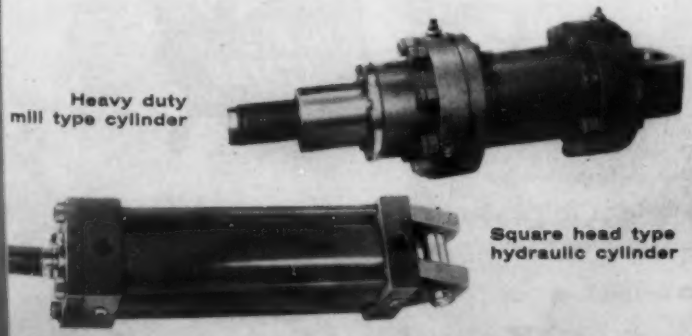

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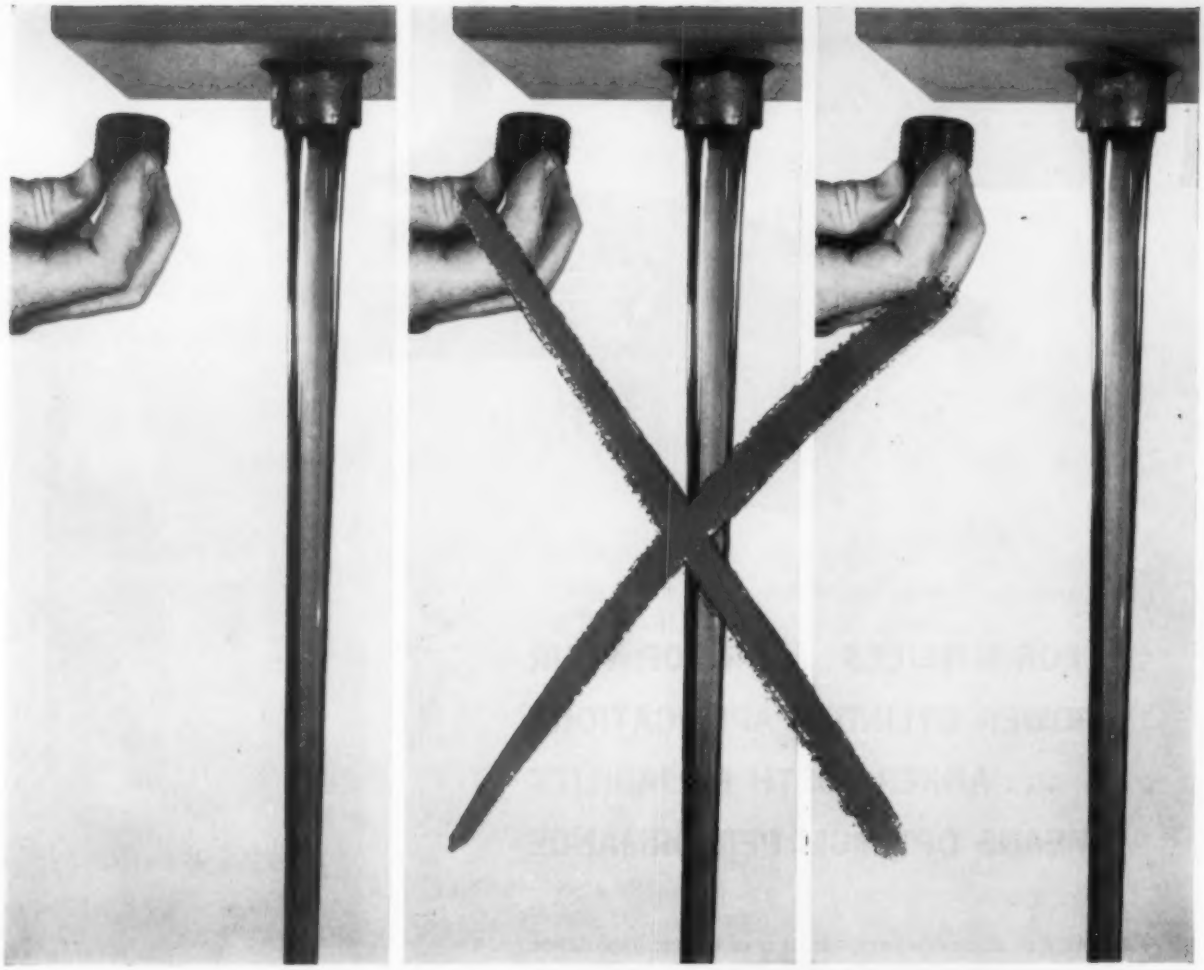

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yet improve hydraulic performance!

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Straight mineral oil may be satisfactory for some systems, but tests show that Regal Oil R&O can extend the interval between draining at considerable savings. This premium oil is formulated to resist oxidation, rust, foam, and wear.

And there's a bonus! When you do drain, you'll find the system in cleaner condition. Save again on make-ready.

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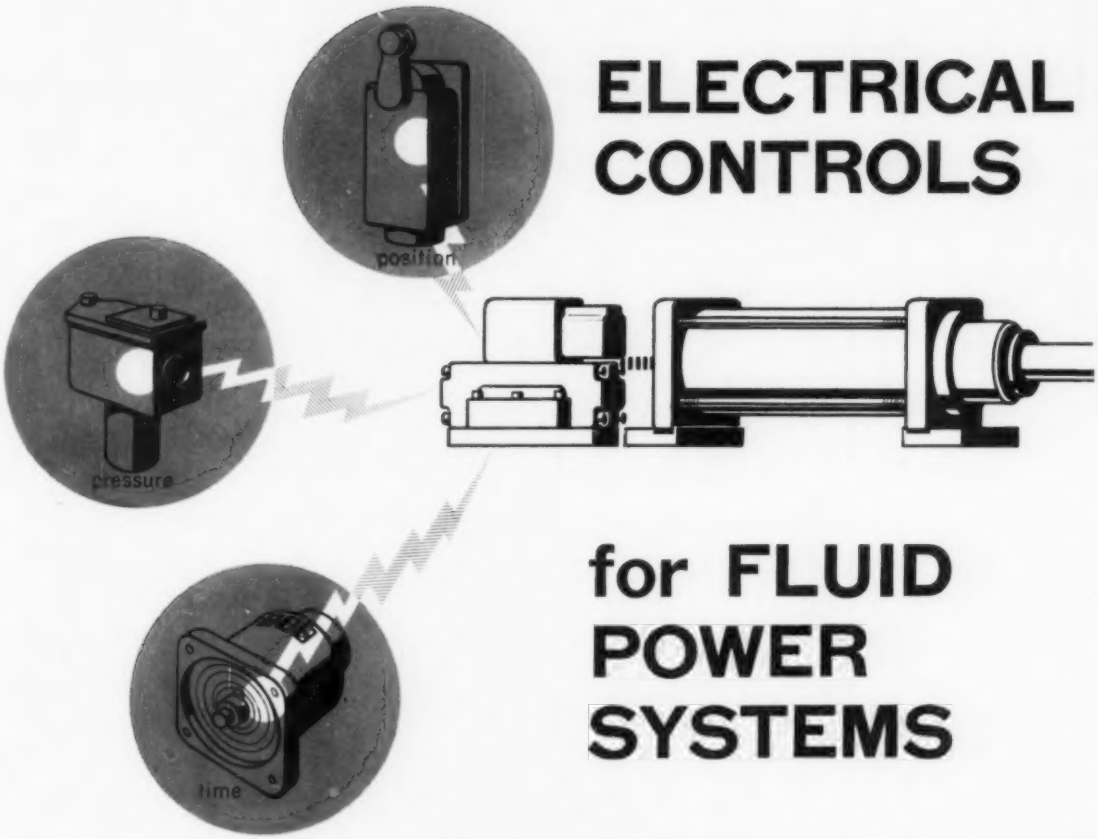
AUGUST 1959



ELECTRICAL CONTROLS for FLUID POWER SYSTEMS

Designers of hydraulic and pneumatic equipment have the job of selecting the electric controls needed to actuate the fluid power system. Automatic operation of solenoid valves is done by:

1. Tripping limit switches at some point during cylinder travel.
2. Actuating a pressure switch at a specified load.
3. Energizing a timing relay to give a fixed time interval.

Overall responsibility for machine controls is an outgrowth of the *system engineering* approach. As machines become more complex, incorporate more interlocked operations, maintenance checking features, and safety devices, system engineering becomes more important. The engineer can no longer simply bolt on a cylinder to push a slide, then pipe up a valve to control it. With highly integrated machines, each component affects the whole operation. Machine performance depends on how well the systems mesh together. This system approach is especially important on servo controlled machines where fast response and accuracy are the design objectives.

To help designers of fluid power systems understand the relationship between electrical and fluid power systems, the following pages are filled with specifications for principal electric components, and articles showing how these control hydraulic and pneumatic systems.

LIMIT SWITCHES

Manufacturer	Model	Actuator	Operating Direction	Maximum Actuator Travel	Distance or Angle To Actuate	Overtravel	Differential	Operation	Contacts	Normal Current Rating (Amps.)	Life Cycles	Enclosure	Special Features
ACRO DIVISION, ROBERTSHAW FULTON CONTROLS CO.	342-0003-12	Roller lever	2-Way	----	[illegible]	[illegible]	[illegible]	(1)	[illegible]	10A	[illegible]	(5)	Head adjusted thru 360°; actuator adj. 360° on axis; dust, oil tight
	1-FHDS-7P8-12	Rubber boot; over-travel; plunger	1-Way	----	0.344"	0.094" min.	0.016"	(1)	2PDT	10A	50,000,000	(5)	Indicating light on switch housing
	1-FHDS-9P8-12	Sealed over-travel plunger with roller positioned lengthwise	1-Way	----	0.344"	0.094" min.	0.016"	(1)	2PDT	10A	50,000,000	(5)	Sealed roller plunger; light on sealing
	1-FHDS-6S8-12	Adjustable roller lever	1-Way	----	0.344"	0.094" min.	0.016"	(1)	2PDT	10A	50,000,000	(5)	Adjustable roller lever; indicating light on switch
	2JY-HD-7P51R-27	Rubber boot; over-travel; plunger on top & bottom of switch	----	----	0.070"	0.110" min.	----	Make-then-plunger action (1)	2PDT	10A	50,000,000	(5)	Plunger on top & bottom of switch; gives reset action
ALLEN BRADLEY CO.	Bul 802T 802TA-W1	Roller lever nylon roller	1-Way	40°± [illegible]	15°± [illegible]	10°± [illegible]	6°± [illegible]	(13)	1 NO, 1 NC DPDT	6 0.4 (115 V DC)	----	(14)	Operating head rotates in four positions; lever adjusts 360°
	Bul 802T 802TMP-W2	Roller lever nylon roller	2-Way	10°	5°	4°	0.1°	(13)	2 NO with movable contact normally in central position	6 0.4 (115 V DC)	----	(14)	Lever moves CW, lower NO contacts close; CCW upper NO contacts close
	Bul 802T 802 AM-W4	Fork lever nylon rollers	1-Way	90° (between limits)	50°± [illegible]	40°± [illegible]	50°± [illegible] to reset	Quick make & break	1 NO, 1 NC DPDT	6 0.4 (115 V DC)	----	(14)	Plunger & track type levers available
	Bul 802T 802TD	Push roller in top of operating head	1-Way	0.35"	0.070"	0.175"	0.051"	(13)	1 NO, 1 NC DPDT	6 0.4 (115 V DC)	----	(14)	Hardened steel roller, actuated by inline motion or gradual rise cams; positive overtravel stop
	Bul 802T 802TW2	Wobble stick in top of operating head	Omni-directional 360°	10°± [illegible]	10°± [illegible]	10°± [illegible]	9°± [illegible]	(13)	1 NO, 1 NC DPDT	6 0.4 (115 V DC)	----	(14)	Operated by moving stick in any direction
CLARK CONTROLLER CO.	DM	Roller lever or shipper rod lever	1-, 2-Way	32°	9°	30°	9°	Quick make & break (1)	1 NO & 1 NC	10	Many millions	Oil tight	Mechanical & electrical sides are isolated
CUTLER HAMMER, INC.	Type P	Push rod and push roller	1 Way	0.438"	0.234"	0.203"	0.188	(1)	1 NO & 1 NC	15	----	Nema 1, Nema 4 oil tight	----
	Type P	Roller lever	1 Way and 2 Way	60°	35°	20°	20°	(1)	1 NO & 1 NC	15	----	Nema 1, Nema 4 oil tight	----
	Precision	Open-type	1 Way or push-button operation	0.140 - 0.150"	0.001 - 0.005"	0.078 - 0.09"	0.046 max.	(1)	1 NO & 1 NC	15	50,000,000	(11)	Basic switch for special applications
	Type E	Rotating shaft	CW or CCW rotating shaft with 2 or 4 limits	1-36 revolutions	1-970 shaft revolutions	1-36 revolutions	1/8 - 13 revolutions	(18)	2 NO & 2 NC or 4 NO & 4 NC	15	20,000,000	Nema 1, 4, 7-9	----
R. B. DENISON MFG. CO.	M	Lever	1-Way CW or CCW	55°	5°	50°	6°	(6)	1 NO & 1 NC (22)	20	40,000,000	Nema 1, 3, 4, 5, 12	4 lug-in precision switch
	L100W2	Lever	1-Way CW or CCW	80°	10°	70°	10°	(6)	1 NO & 1 NC (22)	10	50,000,000	Nema 1, 3, 4, 5, 12	Light operating force
	L100WTL	Lever	1-Way CCW-reversible	80°	10°	70°	10°	(6)	1 NO & 1 NC (22)	10	50,000,000	Nema 1, 3, 4, 5, 12	3 Circuit
	L100WN3	Lever	2-Way neutral position	75°	15°	70°	8°	Snap action (spring return to neutral)	2 NO (22)	10	50,000,000	Nema 1, 3, 4, 5, 12	----
	L100WB0	Lever	1-Way reversible	70°	5° to close NO circuit 4° overlapping travel	70°	----	Make before break - slow make & break	1 NO & 1 NC (22)	Pilot duty	50,000,000	Nema 1, 3, 4, 5, 12	----
ELECTRO-SNAP CORP.	E24-H	Plunger	----	0.375"	0.050"± 0.010	0.313" min.	0.032"± 0.010	Standard on-off	(7)	(8)	100,000 min.	Diecast	----
	E24-HM1	Plunger	----	0.375"	0.050"± 0.010	0.25" min.	0.032"± 0.010	1-Way impulse	(7)	(8)	100,000 min.	Diecast	1-Way impulse action
	E24-K	Plunger	----	0.484"	0.050"± 0.010	0.438" min.	0.032"± 0.010	Standard on-off	(7)	(8)	100,000 min.	Diecast	----
	E24-KM1	Plunger	----	0.484"	0.050"± 0.010	0.375" min.	0.032"± 0.010	1-Way impulse	(7)	(8)	100,000 min.	Diecast	1-Way impulse action
	E24-J	Plunger	----	0.375"	0.050"± 0.010	0.313" min.	0.032"± 0.010	Standard on-off	(7)	(8)	100,000 min.	Diecast	----
GENERAL ELECTRIC CO.	CR9440-E1	Roller line, top & side push rod, top roller	2-Way	36°, 0.35", 0.397"	15°, 0.093", 0.078"	----	----	(9)	1 NO & 1 NC	10	----	Oil tight	(17)
	CR9440-J	Roller lever	1-Way	36°, 33°, 16°	15°, 13°, 11°	----	----	Quick make, spring return or maintained	1 NO & 1 NC	10	----	Oil & water tight	(17)
MICRO SWITCH DIV., MINNEAPOLIS-HONEYWELL REGULATOR CO.	1S1ML1	Roller lever	1-Way (R, L, or both)	70°	15°	60°	7°	(6)	(10)	10 (120, 240, 480, 600 V, AC)	Millions	Oil tight	Heavy duty

	CR9440-J	Roller lever	1-Way	36°, 39°, 16°	12°, 15°, 11°	----	----	Quick make, spring return or maintained	1 NO & 1 NC	10	----	Oil & water tight	----
MICRO SWITCH DIV., MINNEAPOLIS-HONEYWELL REGULATOR CO.	151ML1	Roller lever	1-Way (R, L, or both)	75°	15°	60°	7°	(9)	(10)	10 (120, 240, 480, 600 V. AC)	Millions	Oil tight	Heavy duty
	11LS1	Roller lever	1-Way (R, L, or both)	50°	50°	30°	12°	(9)	(10)	10 (120, 240, 480 V. AC)	Millions	Oil tight	Compact
	201LS1	Roller lever	1-Way (R, L, or both)	50°	50°	30°	12°	(9)	(10)	10 (120, 240, 480 V. AC)	Millions	Oil tight	Plug in
	102ML1	Plunger	In-out	0.540" max.	0.040"	0.500" max.	0.050"	(9)	(10)	10 (120, 240, 480, 600 V. AC)	Millions	Oil tight	Heavy duty
	2LS1	Plunger	In-out	0.270" max.	0.065"	0.250" max.	0.050"	(9)	(10)	10 (150, 240, 480 V. AC)	Millions	Oil tight	Compact
NATIONAL ACME CO.	D-1200X	(11)	2-Way	15° (12)	10°	25°	6°	(13)	1 NO & 1 NC	(14)	To 50,000,000	(15)	(16)
	D-200XST	(11)	2-Way	7° (12)	6° 30'	25°	4°	(13)	1 NO & 1 NC	(14)	To 50,000,000	(15)	(16)
	D-200NPB	(11)	2-Way	7° 30' (12)	7°	25°	6-1/2° return to neutral position	(13)	Neutral center 2 NO	(14)	To 50,000,000	(15)	(16)
	D-2400	(11)	2-Way	15° (12)	15°	24°	8°	(13)	2 NO & 2 NC	(14)	To 50,000,000	(15)	(16)
	D-900-1	Roller plunger	2-Way	0.266" (includes overtravel)	0.047"	See maximum actuator travel	0.031"	(13)	1 NO & 1 NC	15 AMP, 125 V AC 5 AMP, 250 V AC 3 AMP, 460 V AC	To 10,000,000	(15)	Water tight, oil tight
SQUARE D CO.	Class 9007 Type AW16-BA1	Roller arm	1-Way	30°	5°	25°	5° - 4°	Can be changed to maintain contact (3)	SPDT 1 NO & 1 NC	15	----	Oil tight	Plug in
	Class 9007 Type AW36	Roller plunger	2-Way	0.22"±0.063" (2)	0.094"	0.156"±0.063 (2)	0.047"	(3)	SPDT 1 NO & 1 NC	15	----	Oil tight	Plug in (4)
	Class 9007 Type TUB-5	Roller arm	1-Way (can be changed to 2-way)	99°	14°	84°	12°	Can be changed to maintain contact (3)	SPDT 1 NO & 1 NC	15	----	Oil tight	(5)
WESTINGHOUSE ELECTRIC CORP.	PLS	Lever	2-Way	----	6°	25°	----	(16)	NO & NC	15	Good	Oil tight	----
	PRS	Push rod	1-Way	----	0.05"	0.156"	----	(16)	NO & NC	15	Good	Oil tight	----
	TN	Traveling nut	2-Way	160 turns	Several degrees	----	Several degrees	Traveling nut (16)	NO & NC	15	Good	Water tight	----
	A	Shaft rotation belt or chain	2-Way	360°	Several degrees	360°	Several degrees	Cam-operated, slow make & break	NO & NC	10	Good	Nema 1 or weather-proof	----
	CYPAK	Proximity	2-Way	----	2" or 0.5"	Unlimited	0.05 to 0.01	(18)	Static	(15 volt)	Indefinite	Encapsulated	----

(1) Spring return or maintaining contact (2) Depends on plunger arrangement (3) Quick make, spring return (4) Roller direction can be changed 90°, roller can be raised & lowered by ±1/16" (5) Switch mechanism adjustable to 11 different operating sequences (6) Snap action, spring return or maintained contact (7) NO (NC, SPDT, or SPDT 2CKT are available) (8) 10 AMPS at 125/250 V. AC (9) Snap-action, spring-return (10) 2-CKT-DB

(11) Lever with roller, manual lever (12) Recommended actuator travel (13) Snap action, quick make & break - locked contacts, spring return (14) 20 AMPS, 115 V AC 10 AMPS, 230 V AC 5 AMPS, 600 V AC 5 AMPS, 125 V DC (15) Zinc alloy, die cast (16) Water tight, oil tight, double break contacts (17) Interchangeable operating heads (18) Quick make & break (19) 20 AMPS, 250 V AC 1 HP, 125 V AC 2 HP, 250 V AC

(20) Die-cast aluminum (21) Open type switch, variety of operators available (22) Other models available with special contact arrangements (23) Quick make & break, spring return (24) Oil tight, cast aluminum with synthetic rubber gaskets

TIMERS

Manufacturer	Model No.	Type	Operation	Maximum Time Setting	Minimum Time Setting (Sec.)	Repeat Accuracy (%)	Reset Time (Sec.)	Means of Adjustment	Contacts	Normal Current Rating (Amp. 110 VAC)	Special Features
A.G.A. DIV., ELASTIC STOP NUT CORP. OF AMERICA	NE-11 AC ND-11 DC NE-12 AC ND-12 DC	Electro-pneumatic	Time delay begins on energization, instantaneous recycling	(9)	0.1 sec. (needle valve adj.) 0.08 sec. (dial adj.)	±10	0.050	Dial (DE) Needle (NE)	SPDT/DB DPDT/SB (7)	7 (single break) 20 (double break)	(8)
	NE-21 AC NO-21 DC	Electro-pneumatic	Time delay begins on de-energizing, instantaneous recycling	(9)	0.1 sec. (needle valve adj.) 0.08 sec. (dial adj.)	±10	0.050	Dial (DE) Needle (NE)	SPDT/DB DPDT/SB (7)	7 (single break) 20 (double break)	(8)
	NET-11-12-AC NDT-11-12 DC	Electro-pneumatic	2-Step, two adjustable time delays from one relay	15-25 sec. on aux. plus regular (9)	0.08 on aux.	±10	0.050	Dial (DE) Needle (NE)	SPDT/DB DPDT/SB (7)	7 (single break) 20 (double break)	2-Step (8)
	NED-11-12 NDD-11-12 NFD-11-12	Electro-pneumatic	Time delay on energ. time delay on de-energ.	(9)	0.08 on aux.	±10	0.050	Dial (DE) Needle (NE)	SPDT/DB DPDT/SB (7)	7 (single break) 20 (double break)	Time delay independently adjustable on energizing & de-energizing. (8)

TIMERS (continued)

	Model No.	Type	Operation	Maximum Time Setting	Minimum Time Setting (Sec.)	Repeat Accuracy (%)	Reset Time (Sec.)	Means of Adjustment	Contacts	Normal Current Rating (Amp. 110 VAC)	Special Features
ALLEN BRADLEY CO.	Bulletin 800	Fluid dashpot	Automatic reset	30 sec.	5	± 15	0.5	Adj. fluid dashpot	1 NO (Standard) 1 NC (Special)	6	Hand reset contact block
	Bulletin 849	Pneumatic	Automatic reset	120 sec.	0.15	± 10	0.075	Needle valve	1 NO & 1 NC	6	Auxiliary contacts, dial indicator, maintained contact timing unit
	Bulletin 855	Electronic	Automatic reset	120 sec.	0.025	± 2	0.05	Potentiometer dial	2 NC, or 2 NC, or 1 NO & 1 NC	6	----
AUTOMATIC TIMING & CONTROLS, INC.	308	Electro-mech.	Auto-reset & non-reset upon power interruption	60 hrs.	0.25	0.25	Less than 0.1	Dial	2 NO & 2 NC	10	Field selection of 147 circuits
	306	Electro-mech.	Repeat cycle	240 min.	1	0.25	Non reset	Dial	2 SPDT	10	Adjustable dwell period before reversal
	1300	Electronic	Interval -- reset or holding	120 sec.	0.02	0.1 (of setting)	5 M.S.	Dial	2 DPDT relays	15	Remote dial, time calibrated dial
	3400	Pneumatic	Repeat or stop cycle	100 hrs.	1.5	0.25	----	Cams	NO & NC	----	High bleed capacity, poppet valves 5 cfm @ 80 PSI
	304	Electro-mech.	Cycle repeat	60 sec.	1	0.25	----	Dial	NO	25	Includes on-off switch
A. W. HAYDON CO.	12600 Series	Electrical	Repeat cycle, interval or single cycle	360 min.	0.1	1	----	Cam	11 SPDT	10	Factory adjusted or field adjustable
	11400 Series	Electro-Mech.	Time delay, automatic reset on power interrupter	30 min.	1.5	2	0.5	Cam or dial	4 SPDT	10	Military or commercial application
	41900 Series	Electrical	Repeat cycle, interval or single cycle	24 hrs.	0.9	1.5	----	Fixed	8 SPDT	15	Quick-connect terminals, optional mounting,
THE BELLOWS COMPANY	BT-2	Electronic	Time delay	15 sec.	0.025	1	0.05	Dial	NO & NC	10	----
	BDT-1	Electronic	Time delay, dual circuit	15 sec.	0.025	1	0.05	Dial	NO & NC	10	----
CLARK CONTROLLER CO.	PMT	Pneumatic	Magnetic operation, automatic reset	180 sec.	0.2	± 10	0.05	Screw	1 NC & 1 NC or 2 NC & 2 NC (1)	10	Modular construction, converted easily in the field, on & off delay
CRAMER CONTROLS CORP.	541E	Electro-mech.	Automatic reset, interval timer	6 sec. - 24 hrs.	0.2 sec. - 1 hr.	± 0.25 total time range	6.5	Dial & pointer	NO & NC	0.02	15-AMP contact rating, integral pushbutton start, progress pointer
	412E	Electro-mech.	Time delay relay	6 sec. - 24 hrs.	0.2 sec. - 1 hr.	± 0.25 total time range	0.5	Dial & pointer	NO & NC	Motor - 0.02 Clutch - 0.06	15-AMP contacts, wide selection of control arrangements, progress pointer
	511-521	Electro-mech.	Cycling	6 sec. - 48 hrs.	11° of cam travel	± 1.5°	----	Cam & dial	SPDT	0.02	Available in 1 to 8 poles, 20 AMP contact rating
	610E	Electro-mech.	Cycling percentage timer	15 sec. - 24 hrs.	4% of total	1 (of total)	----	Dial & pointer	NO or NC	0.02	Available with 20-AMP contacts
	650F	Electro-mech.	Cycling pulse timer	15 sec. - 24 hrs.	0.5 sec. - 12.0 min.	2 (to 60 sec.) 1 (longer ranges)	----	Dial, pointer & stop	NO or NC	0.02	Interval is adjustable, pulse is factory set
CUTLER HAMMER, INC.	10336	Synchronous motor driven	Automatic reset	60, 120, 300 sec., & 30 min.	2, 6, 10 & 30	2.5	0.0167	Dial	NO, NC	10	Setting in actual time divisions - time elapsed indicated
	13622	Electronic	Automatic reset on delay	60 sec.	0.15	2	0.5	Dial	NO, NC	10	----
	10337	Pneumatic	Automatic reset on, off delay	60 sec.	0.3	10	0.1	Slotted needle valve	NO, NC or 2 NO, NC	10	Closed air system, 2-step timing
EAGLE SIGNAL CORP.	110	Electro-mech.	Automatic reset	20 hrs.	0.3	0.1 (max.)	0.7 (full scale)	Dial	Adjustable	15	Micrometer dial, plug-in
	120	Electro-mech.	Automatic reset (repeat cycle switch optional)	5 hrs.	0.5	0.33 (of full scale)	0.4 (full scale)	Dial	Adjustable	10	1-6 individual circuits, vernier adjustment
	150	Electronic	Automatic reset	10 sec.	0.05	2 (of dial setting)	0.05	Dial	Adjustable	5	4" dial, plug-in
	160	Pneumatic	On or off delay	180 sec.	0.2	± 10	----	Adjustment screw	2-circuit type	20	Temperature compensated timing unit

	150	Electronic	Automatic reset	10 sec.	0.05	2 (of dial setting)	0.05	Dial	Adjustable	5	4 ranges, plug-in
	160	Pneumatic	On or off delay	180 sec.	0.2	± 10	----	Adjustment screw	2-circuit type	20	Temperature compensated timing unit
	220	Electro-mech.	Repeat cycle	30 hrs.	1	0.2 (of full scale)	----	Adjustment screw	SPDT	10	Extra large dial
G. C. WILSON & CO.	----	1 Repeat cycle timer, electronic	Auto repeating	200 sec.	0.2	±1	----	Dial	DPDT	15	Wide range, coat of adjustment, automatic starting
	191	Time delay relay electronic	Time delay after energizing, instant reset	300 sec.	0.003	±5	0.002	Screw	DPDT	10	Plug in unit, remote time adjustment
	12MC	Interval timer electronic	Adjustable interval with instant reset	50 sec.	0.06	±2	0.001	Dial	SPST	8	Operates from momentary or sustained impulse, instant reset
GENERAL ELECTRIC CO.	CR 2850-1740	Motor driven	T.D. after energ. not auto reset	6.67 hrs.	3	±0.3 of max. setting	0.6 (approx.)	Dial	1 NO - 1 NC	15	Stepless adj., expired time indicator
	CR 2850-A	Pneumatic	T.D. after energ. or after de-energ.	180 sec.	0.10	±10 of avg. setting	0.6 (approx.)	Screw	2 NO - 2 NC	25	----
	CR 7004-A142	Electronic	----	120 sec.	0.06	±2 of max. setting	0.1 - 6	Dial	1 NO - 1 NC	10	----
HAYDON DIV., GENERAL TIME CORP.	DA21	Electro-mech.	Armature reset	570 sec.	0	5	1.5 - 120	Dial	NC, NC	20	Fixed adjustment (2)
	DA11	Electro-mech.	Armature reset	270 sec.	0	--	1.5 - 120	Dial	NC, NC	20	U/L approved, easily adjustable (2)
	RB & RD	Cycle electro-mech.	Repeat cycle automatically or manually triggered	3600 sec.	6° ± 3 knife 10° ± 6 roller	--	----	Cam	NC, NC	20	U/L approved (2)
	AD	Interval electro-mech.	Shuts off after predetermined time	1440 sec.	0	--	----	Dial	NO or NC	20	U/L approved, manual set (2)
INDUSTRIAL TIMER CORP.	Series CM, MC, RA, RC	(3)	Recycling & single cycle	72 hrs.	0.667	0.25	----	Cam	SPDT	10	U/L listed, available up to 20 switches
	Series TDAB	(3)	Time delay timer, auto reset	3 hrs.	0.0167	0.1	0.3	Dial	SPDT	10	Dial adjustment, extremely accurate
	Series PAB	(3)	Interval timer, auto reset	3 hrs.	0.0167	0.1	0.3	Dial	SPDT	15	Auto reset
	Series TH	Thermal switch	Bi-metal flex with local heat	5 min.	2	±10	----	Screw	SPDT (4)	10 (standard) 20 (optional)	Temperature compensated, snap action contacts adjustable
SEELY INSTRUMENT CO., INC.	TFB	(5)	Auto reset	60 hrs.	0.5	0.25	Instant	Pointer on dial	NO & NC	10	Built-in push-button
	ECA-3	(5)	Auto reset	60 hrs.	0.5	0.25	Instant	Pointer on dial	Custom	10	Custom circuits
	DT-3	(5)	Gears to complete cycle in required time	4 hrs.	3.75	0.25	30	Segments on drum & gears	To 10 NO, 10 NC	10 per circuit	Up to 10 air pilot valves
	IRC-1	(5)	Auto reset	60 hrs.	30	0.25	1	Pointer on dial, segment on cam	2 NO, 2 NC	10 per circuit	One air pilot valve, adjust cure time on dial
	TB-3	(5)	Auto reset	Up to weeks	5	--	Instant	Pointer on dials, plugs into plug-board	To 7 NO, 7 NC	10 per circuit	Complete instantaneous flexibility in time or sequence, all plug-in components
WESTINGHOUSE ELECTRIC CORP.	Type AM	----	Magnet operated	300 sec.	0.40	10	Instant	Dial	NO - NC	15	Timer element is detachable; can be easily converted from on to off delay
	Type TK	----	Motor operated	10 min.	2	good	Instant	Dial	NO - NC	15	Has clutch for inst. use
	Cycak Timer	----	Static -- capacitor charge	30 sec.	0.2	good	0.5 cycle	Rheostat	Static	----	Used in static control circuits
	AQ, AQZ, AZ	----	Inductive time delay	3 sec.	0.5	good	Short	Copper sleeves or resistance	NO - NC	5-300	Used as combination timer & accelerating contactor
	1A	----	Electronic	120 cycles	2 cycles	good	Short	Rheostat	NO - NC	15	----

(1) Up to 6 instantaneous contacts (2) Wide choice of timing intervals (3) Synchronous motor driven (4) Many others optional (5) Electric synchronous motor (6) Depending on power frequency accuracy (7) Each unit has two sets, NO & NC (8) Instantaneous recycling, unaffected by voltage variation, easy adjustment (9) 10 min. (needle valve adj.) 15 min. (dial adj.) 5 timing ranges

SOLENOIDS

Manufacturer	Model	Type	Maximum Stroke (Inches)	Force at Maximum Stroke (Lb.)	Force at Minimum Stroke (Lb.)	Current at Maximum Stroke (Amp.)	Current at Minimum Stroke (Amp.)	Operation	Life Cycles	Special Features	Operating Voltage
ALLEN BRADLEY CO.	Bulletin 660 Continuous	Push or pull	1.5 (also 2)	25.1 (10)	6.66 (10)	2740 Inrush (17) 309 Sealed (17)	75.6 Inrush (17) 17.6 Sealed (17)	Continuous	----	Wall or universal mounting	110-550 V AC
	Bulletin 660 Intermittent	Push or pull	1.5 (also 2)	25.1 (10)	6.79 (10)	5930 Inrush (17) 470.8 Sealed (17)	116.5 Inrush (17) 40.5 Sealed (17)	Intermittent	----	Wall or universal mounting	110-550 V AC
AUTOMATIC SWITCH CO.	10625	Pull	1	1	6	(1)	(1)	Continuous	(1)	Tapered plunger; relatively flat force stroke	DC
	10631OF	Pull	2	2	25	(1)	(1)	Continuous	(1)	Tapered plunger; relatively long stroke; flat force stroke	DC
	10631A	Push	1.5	5	110	(1)	(1)	Continuous	(1)	Cone & plunger; for cutting operations	DC
	10432	Pull (3)	1.125	0.5	4.5	1.75 (4)	0.32 (4)	Continuous	(1)	Hexagon shaped plunger; cylindrical brass sleeve	AC
	10433	Pull (3)	1.5	2.2	6	4.3 (4)	0.8 (4)	Continuous	(1)	Cast frame, rigid construction	AC
CEPPARD INSTRUMENT LABORATORY	AVS-24 DC	Push	0.115	1.39	3.5	0.33	0.33	Continuous	Long life	Nyiclad wire	24 V DC
	AVS-115 DC	Push	0.115	1.39	3.5	0.066	0.066	Continuous	Long life	Nyiclad wire	115 V DC
	AVS-115 AC	Push	0.5	1.7	4.2	1.12	0.75	Continuous	Long life	Molded epoxy coil	115 V AC
	AVS-230 AC	Push	0.5	1.7	4.2	0.56	0.38	Continuous	Long life	Molded epoxy coil	230 V AC
CUTLER HAMMER, INC.	A	Pull or push	1	0.72	----	1.83	0.34	Continuous	----	(5)	110-550 V AC
	B	Pull or push	1	4.2	----	5.4	0.87	Continuous	----	(5)	110-550 V AC
	C	Pull or push	1.25	7.0	----	10.4	1.07	Continuous	----	(5)	110-550 V AC
	D	Pull or push	1.25	12.4	----	18.0	1.58	Continuous	----	(5)	110-550 V AC
DETROIT COIL CO.	"O" Series	Push or pull	0.5	1.5 - 2.4	4.75 - 6.5	1.12 - 1.61	0.23 - 0.26	Continuous	Depends on use	Molded coil	115-460 AC
	Teen Series	Push or pull	0.5	2.0 - 10.25	5.5 - 16.0	1.31 - 5.30	0.25 - 0.60	Continuous	Depends on use	Shock mounted	115-460 AC
	Twenty Series	Push or pull	0.75	12.25 - 15.0	25.0 - 28.0	10.4 - 13.4	1.0 - 1.2	Continuous	Depends on use	Shock mounted	115-460 AC
	Fifty Series	Push or pull	1	15.0 - 30.0	40.0 - 50.0	20.2 - 26.5	1.25 - 1.52	Continuous	Depends on use	Shock mounted	115-460 AC
	171 Series	Push	0.313	4.75 - 5.5	8.0 - 12.0	2.32 - 3.65	0.405 - 0.59	Continuous	Depends on use	Oil immersed	115-460 AC
	191 Series	Push	0.5	4.5 - 10.25	8.0 - 18.0	2.9 - 4.6 (115 V AC)	0.405 - 0.570 (115 V DC)	Continuous	25 Million +	Oil immersed, plug in	115-460 AC
	24 Series	Push or pull	0.5	3.75	32.0	0.313 (115 V DC)	0.313 (115 V DC)	Continuous	Depends on use	Totally enclosed	12-250 DC
	25 Series	Push or pull	0.5	16.0	50.0	0.478 (115 V DC)	0.479 (115 V DC)	Continuous	Depends on use	Totally enclosed	12-250 DC
	26 Series	Push	0.5	16.6	35.0	5.00 (115 V DC)	0.130 (115 V DC)	Continuous	Depends on use	Totally enclosed	12-250 DC
	29 Series	Push	0.5	42.0	46.0	14.7 (115 V DC)	0.365 (115 V DC)	Continuous	Depends on use	Totally enclosed	12-250 DC
DORMEYER INDUSTRIES	2000 C-T #271	Push	0.313	7.5	25	4.5	0.7	Intermittent	25 Million +	Double-shaded, molded coils; shock-mounted	AC
	2000 C-I #7110-14A	Push (6)	0.5	3	12	3.5	0.7	Intermittent	1-5 Million	Single-shaded coils; standard stack 1"; rugged construction	AC
	2000 C-T #230-1	Pull	1	1.5	17	4.5	0.5	Continuous	Varies	(7)	AC
	2000 C-T #231-1	Pull	1	3	28	6.2	0.7	Intermittent	Varies	(7)	AC
GENERAL ELECTRIC CO.	CR9500	Pull or push	1	1-27	9-60	30-3900 (17)	40 - 150 (17)	Continuous	----	Strong box coil; glass fibre guide; versatile wiring	110-550 V AC 115-230 V DC
	CR9503	Pull or push	3	10-70	----	5330-31,500 (17)	300 - 1760 (17)	Continuous	----	----	110-550 V AC 115-230 V DC

GENERAL ELECTRIC CO.	CR9500	Pull or push	1	1-27	9-60	30-3900 (17)	80 - 1560 (17)	Continuous	----	----	110-550 V AC 115-230 V DC
	CR9503	Pull or push	3	10-70	----	5550-81,900 (17)	500 - 1760 (17)	Continuous	----	----	
G. H. LELAND, INC.	1E	Rotary	40°	0.2 (8)	0.6 (8)	0.30 (8)	0.30 (8)	(10)	4 Million	-----	DC
	3E	Rotary	67-1/2°	0.6 (8)	1.3 (8)	0.30 (8)	0.30 (8)	(10)	4 Million	-----	DC
	5E	Rotary	95°	0.98 (8)	7.3 (8)	0.77 (8)	0.77 (8)	(10)	4 Million	-----	DC
	6E	Rotary	95°	3.3 (8)	16.2 (8)	1.5 (8)	1.5 (8)	(10)	4 Million	-----	DC
	8E	Rotary	95°	10 (8)	60 (8)	1.5 (8)	1.5 (8)	(10)	4 Million	-----	DC
NATIONAL ACME CO.	3KS00-B	Push or pull	0.5	5.5	10	4	0.40	Continuous (14)	----	(16)	(15)
	3KS00-C	Push or pull	0.5	9	18	4.5	0.5	Continuous (14)	----	(16)	(15)
	3KS00-D	Push or pull	0.5	16.5	34	7	0.5	Continuous (14)	----	(16)	(15)
	4KCP	Push	0.5	4	12	5.9	0.50	Continuous (14)	----	(16)	(15)
	4KDP	Push	0.5	8.5	16	4.5	0.50	Continuous (14)	----	(16)	(15)
PSP ENGINEERING CO.	10SD 60-3	Pull	0.062	3	4.5	0.400	0.400	Continuous	25,000 min.	Single coil sealed against internal fluid pressure; 1" dia. (11)	18-30 V DC
	16SD743-4	Pull	0.030	30	----	3.5	3.5	Continuous	300 hrs. 500 strokes min.	Single coil, potted; 1.710" dia. (12)	18-30 V DC
	20SD620-1	Push	0.250	6.5	10	0.9	0.09	Continuous	25,000 min.	Two coil; 2.00" dia. (18)	115 V AC 400 cyc.
	20SD743	Pull	0.100	60	80	16	0.60	Continuous	25,000 min.	Two coil; 2.00" dia. (11)	18-30 V DC
	13SD127-1	Pull	0.062	28	80 (hold)	3.5	0.180	Continuous	25,000 min.	Two coil; 1.250" dia. (11)	18-30 V DC
TROMBETTA SOLENOID CORP.	NA 704	Push or pull	0.5	8.6 (20) 15.0 (21)	15.0 (20) 18.5 (21)	6.0 (23)	0.6	Continuous (23)	To 8 million	Potted or standard	To 750 V AC or DC
	NA 736	Push or pull	1	16.0 (20) 21.0 (21)	21.0 (20) 29.0 (21)	15.0 (23)	1.4	Continuous (23)	To 8 million	Potted or standard	To 750 V AC or DC
	NA 750	Push or pull	0.5	16.0 (20) 21.0 (21)	21.0 (20) 29.0 (21)	15.0 (23)	1.4	Continuous (23)	To 8 million	Potted or standard	To 750 V AC or DC
	NA 764	Push or pull	1	16.0 (20) 21.0 (21)	21.0 (20) 29.0 (21)	22.0 (23)	1.8	Continuous (23)	To 8 million	Potted or standard	To 750 V AC or DC
	NA 772	Push or pull	1	20.0 (20) 28.0 (21)	28.0 (20) 39.0 (21)	30 (23)	2.3	Continuous (23)	2 Million	Standard only	To 750 V AC or DC
WEST COAST ELECTRICAL MFG. CORP.	100 Series	Push or pull	0.875	2-6	2-6	2-6	0.300-0.600	Continuous or intermittent	----	Replacement coils	AC 60 cycle
	200 Series	Push or pull or push-pull	1	5-20	5-20	6-16	0.500-0.900	Continuous or intermittent	1 Million	Replacement coils	AC 60 cycle
	AC-140	----	0.060	3	11	450 V.A.	300 V.A.	Continuous	30,000	600°F AMB. continuous duty, non-rectified	115 V. 320-500 cycle
	A-692	----	Adjustable	1 @ 0.125" 3.25 @ 0.063"	----	0.128	----	Continuous	----	Diodes potted in unit, sealed plunger cavity	115. V. 400 cycle

(1) DC solenoids - current curve at min. & max. strokes, dependent on operating voltage (2) Dependent on operating conditions (3) Push types available (4) Based on 115 V AC (5) Stainless steel plunger guides (6) Pull optional (7) Adaptable for valve operations; vertical, horizontal, swivel or channel mountings available (8) Torque (in-lb) (9) For intermittent duty cycle, 85 V DC

(10) Intermittent & continuous (11) -65 F to 100 F temp. range (12) -65 F to 165 F temp. range (13) 5000 #, internal pressure (14) Higher force available on intermittent (15) All AC or DC voltages to 600 V (16) Molded; water & oil tight, epoxy resin potted coils (17) Volt-amperes

(18) -65 F to 125 F temp. range (19) With gravity, 100% voltage (20) 80% Voltage (21) 100% Voltage (22) 110% Voltage (23) Intermittent available

PRESSURE SWITCHES

Manufacturer	Model	Type	Medium	Minimum Pressure Setting (PSI)	Maximum Pressure Setting (PSI)	Differential (PSI)	Contacts	Normal Current Rating (Amp - 110 VAC)
ALLEN BRADLEY CO.	Bulletin 836 Style T	Bellows & piston	Air, water, oil	0	5000	(12)	(14)	6
ALLOY BELLOWS ENGINEERING CO.	Series 100	Piston	All	5	3000	7-1/2%	NO, NC DPDT DPDT SPDT DPDT	2 (10)
	Series 600	Piston	All	5	1200	7-1/2%	NO, NC DPDT DPDT SPDT DPDT	2 (10)
AUTOMATIC TIMING & CONTROLS, INC.	6001A-6182	Bourdon tube	All	0.015	10,000	0.01% of range	NO or NC	5
BARKSDALE VALVE	312	Bourdon tube (3)	All	15	2500	(5)	NO and NC	10
	1100	Multiple diaphragm (3)	All	2	4000	(5)	NO and NC	10
	9612	Piston (3)	All	15	5000	(5)	NO and NC	10
	372	Bourdon tube (4)	All	15	2500	(5)	All	10
	9622	Piston (4)	All	15	5000	(5)	All	10
BENJAMIN LASSMAN & SON	-----	Piston	Oil, synthetic fluid	100-1000	1500-3000	10% of setting	NO, NC	10
CUTLER-HAMMER, INC.	10014	Bourdon tube	Oil, water, air, etc.	6	7000	1-5000	1 NO or 1 NC	10 AMP
GENERAL ELECTRIC CO.	CR2922	Bourdon tube	Many gasses, H_2O	30	5000	Adjustable	NO & NC	10
HAYDON SWITCH, INC.	1500 Adjustable	Diaphragm or piston (16)	All	0.5	4000	10% max.	SPDT or DPDT	8
MERCOID CORP.	DA-21	Bourdon tube (6)	(7)	(8)	(9)	0-1000, 100 psi 0-1500, 150 psi	Mercury switch NO, NC or SPDT	10 (SPST)
	DA-621	Bourdon tube (6)	(7)	(8)	(9)	0-1000, 50 psi 0-1500, 100 psi	SPST, NO or NC	5
OIL DYNE, INC.	100	Piston	(11)	50	5000	85-400	One switch NO or NC	5
	200	Piston	(11)	50	5000	85-400	Two switches NO or NC	5
SQUARE D CO.	9012 ADW3	Piston	Oil, synthetic fluid	135 (1)	1000 (1)	35-135 (2)	1 NO, and 1 NC	15
	9012 ADW4	Piston	Oil, synthetic fluid	400 (1)	3000 (1)	100-400 (2)	1 NO, and 1 NC	15
	9012 ADW7	Piston	Oil, synthetic fluid	650 (1)	5000 (1)	125-400 (2)	1 NO, and 1 NC	15
UNITED ELECTRIC CONTROLS CO.	J6	Bellows	-----	30" HG VAC	1700	5±1" water and up	NO, NC or DT	15 or 20 (13)
	J11	Bellows	-----	30" HG VAC	1700	12±4 oz. and up	NO, NC or DT	15 or 20 (13)
VICKERS, INC.	931-02	Piston gasket mtd.	Petroleum and synthetic fluid	3 ranges 100, 100, 500	3 ranges 1000, 3000, 5000	50	NO and NC 2 switches	10 (110-125 V)
	ST1-02	Piston, threaded connections	Petroleum and synthetic fluid	3 ranges 100, 100, 500	3 ranges 1000, 3000, 5000	50	NO and NC 2 switches	10 (110-125 V)

(1) Rising pressure

(2) Adjustable - subtract from rising point

(3) Single setting

(4) Double setting

(5) Fixed from .5" water to 1000 PSI, depending on model & snap action switch.

(6) Outside adjustment (visible scale); mercury switch

(7) Any mediums not injurious to chrome moly or steel

(8) 17 ranges from 0-60 lbs. to 2900 PSI

(9) Full scale for range

(10) 125/250 volts AC

(11) Hydraulic oil as standard. Specials for water, gases.

(12) 110/550 V AC

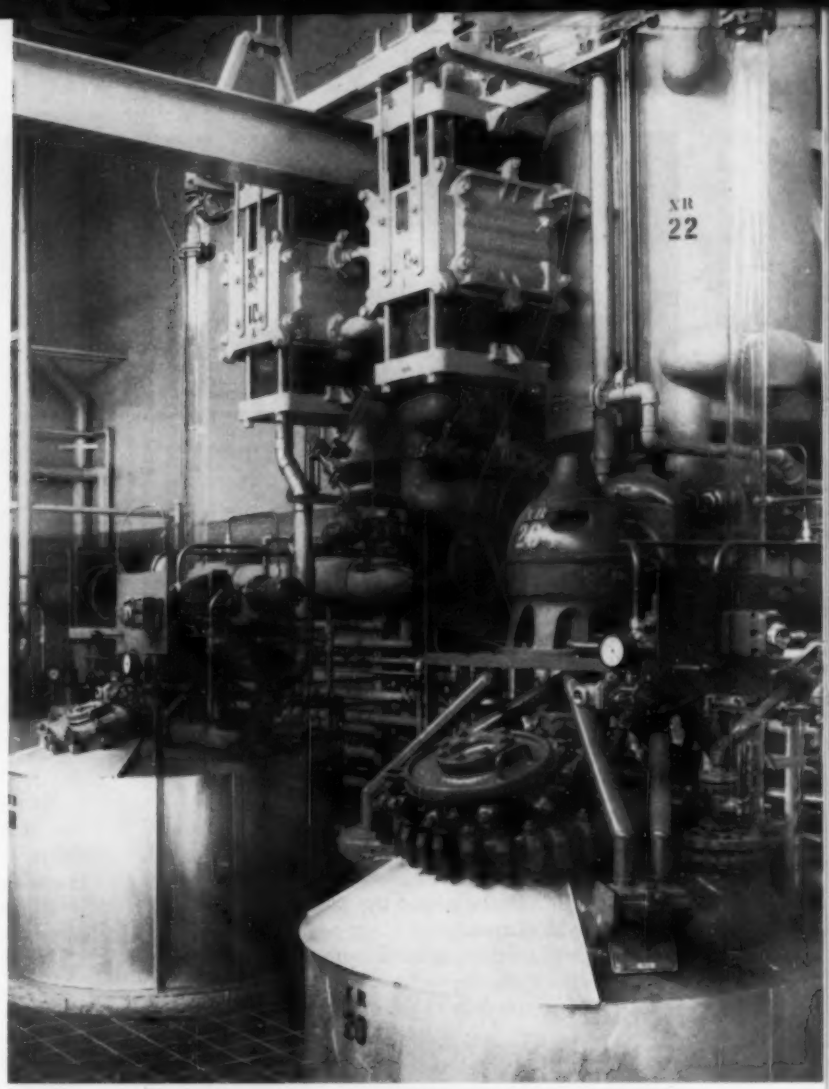
(13) 0.5-1.5, 0.9-6, 3-15, 3-55, 5.5-45, 8-95, 20-150

(14) Two isolated circuits, one with NO contacts, and one with NC contacts

(15) 3-15, 6-28, 10-50, 17-85, 25-125, 35-135, 100-400, 175-650, 70-100, 125-150, 210-300, 450-475

(16) Depending on pressure

Using a pressure compensated pump to supply a meter-in speed control system avoids power waste of a fixed displacement system which would dump over a relief valve. However, some modifications may be required to prevent hunting between the pump compensator and the flow control valve compensator spool.



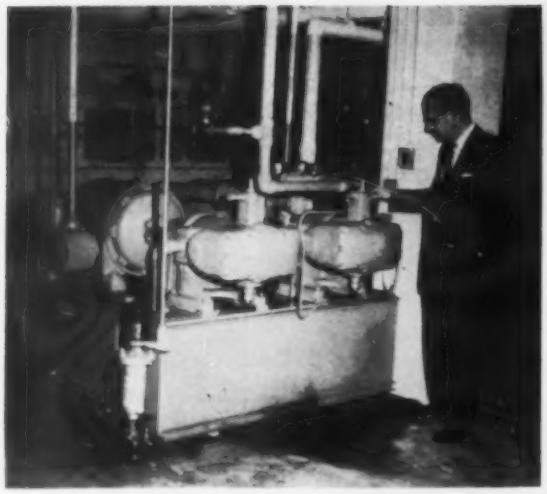
THESE TWO AGITATOR VATS are part of a group which are driven by individual fluid motors supplied by pressure compensated pumps. Individual flow control valves and shut-off valves are mounted at each vat.

Circuit changes prevent hunting of compensated pump

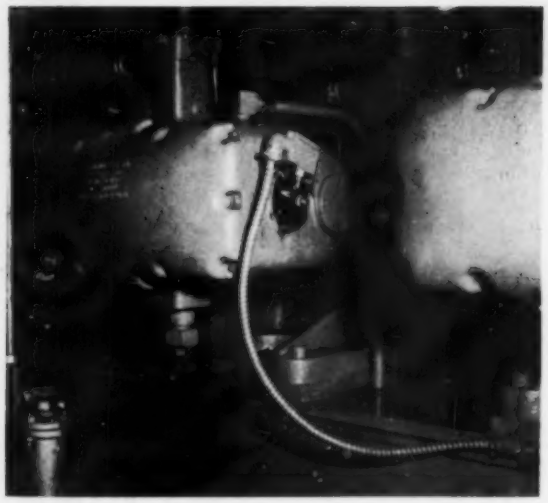
• By JOHN P. SHARP, *Denison Engineering Div., Columbus, Ohio,*
and JOHN P. SNYDER, *Engineering Department, CIBA Pharmaceutical Products Inc., Summit, N. J.*

FLUID motors are particularly suited to the job of driving agitators which mix pharmaceuticals. First, the agitator speed must be infinitely variable, so that the manufacturing chemist can determine the exact optimum for each process. Second, speed must remain constant regardless of torque which depends on thickness of the mixture.

At Ciba Pharmaceutical Products, ten mixing vats are agitated by individual fluid motors mounted on each vat and connected to the agitator through a 20:1



TWO PUMPS, each of 35-gpm capacity, deliver any flow from 0 to 70 gpm at constant pressure required to agitate the mixture. John Sharp is shown adjusting the pump compensator.



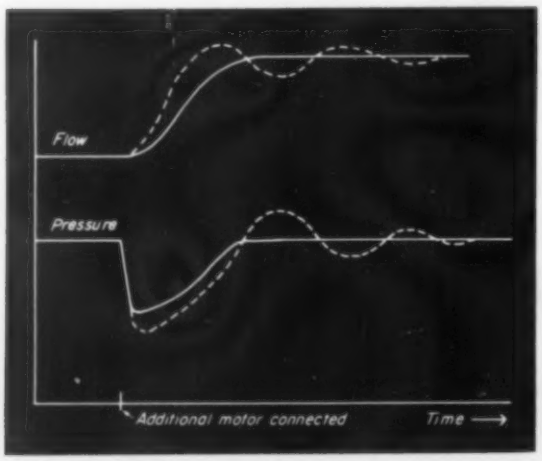
A LIMIT SWITCH actuated by the displacement indicator of one of the pumps trips at full displacement position to start the electric drive motor of the second pump.

speed reducer. The motors are connected in parallel through manually operated shut-off valves. Individual, pressure compensated flow control valves which meter flow into the motors adjust the speed of each motor from 0 to 1800 rpm.

Two, pressure-compensated pumps of 35-gpm capacity each supply the system. They can deliver from 1 to 70 gpm, according to the number of motors which are connected to the pressure header. Only one pump delivers to the system until it reaches maximum displacement.

A limit switch which is actuated by the displacement indicator of this pump is then tripped to start the electric motor driving the second pump.

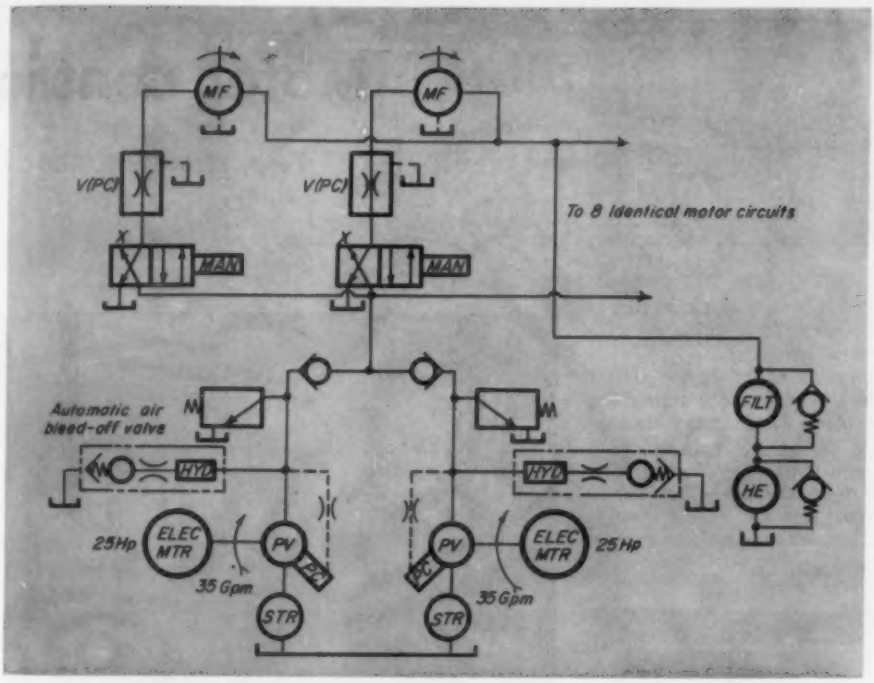
Each axial piston pump is pressure compensated by a spring-loaded poppet device which opens when system pressure reaches the spring setting. This pressure then acts on a piston which pushes the pump hanger toward a neutral (zero-delivery) position, against the force of a spring. As the hanger moves, pump delivery decreases and system pressure drops. The spring-loaded poppet then stabilizes and meters a correct amount of oil into the piston, allowing it to just balance the spring force and maintain the hanger at a fixed position. The position of the hanger will stay fixed until flow demand either increases or decreases.



PRESSURE-FLOW RELATIONSHIP of ideal system operation is shown by solid lines. When additional motor is connected to the system, pressure drops and pump flow increases. System is again stabilized at new flow when pressure reaches pump compensator setting. Dashed line shows how hunting occurs. Abnormal flow through metering valve drops pressure lower than under ideal operation, and flow is correspondingly higher. Pressure and flow oscillate about their steady state values until they finally stabilize.

• **Normal system operation**—In this application, the pump moves to a new displacement each time an additional fluid motor is connected into the system. If all fluid motors are set for the same speed (flow control valves set alike) opening the shut-off valve to a second motor with one motor running, initially drops system pressure to one half its former value, since oil now has twice the area through which to flow. This drop in pressure allows the pump compensator to remain closed, so that the pump hanger spring can increase displacement and delivery. As delivery increases, so does pressure, until it again reaches the point where it opens the pump compensator. The system is then stabilized about that pressure and flow.

The function of the pressure compensator spool in each flow control valve is to maintain a constant



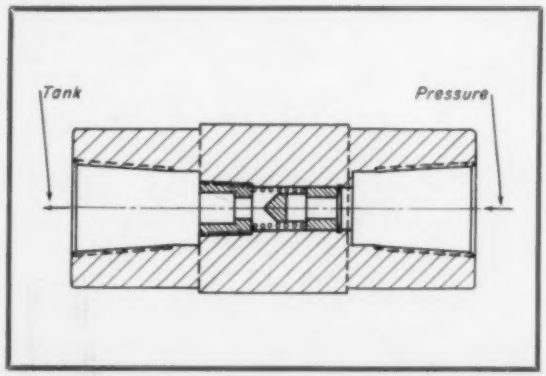
TEN AGITATOR DRIVE MOTORS are connected through manually operated valves to a common header. Inter-action between pressure compensated flow control valves and pressure compensated pumps originally produced hunting when an additional fluid motor was connected to the system.

pressure drop across the valve's metering orifice. It does this by reducing valve inlet pressure according to outlet pressure which is a function of load on the fluid motor.

• **Why it hunts**—When there is no flow through the valve, the spring-loaded compensator spool is in its wide open position. Initial flow through the valve is higher than normal regulated flow because of the abnormal pressure drop across the metering orifice before the compensator can control pressure.

Because the valve initially passes more than its regulated flow, system pressure falls correspondingly lower and pump displacement moves to supply the abnormally high flow. When the flow control valve compensator moves to its proper position, it reduces flow, raises pressure, and signals the pump to reduce displacement. Because the pump overshoots in correcting its displacement, it reaches a delivery less than that required. The flow control compensator then moves to maintain its flow setting. This action continues, as illustrated in the curves showing the relationship between pressure and flow, until the system stabilizes.

• **Damping prevents hunting**—Two modifications were made to eliminate this hunting. An .040-in. orifice was installed in the sensing line which connects system pressure to the pump compensator. This slows down action of the pump hanger to damp its movement. To prevent the flow control compensator from moving to a wide open position, a 1/16-in. washer was installed under the compensator spool to prevent overtravel and to limit its position with no oil flowing



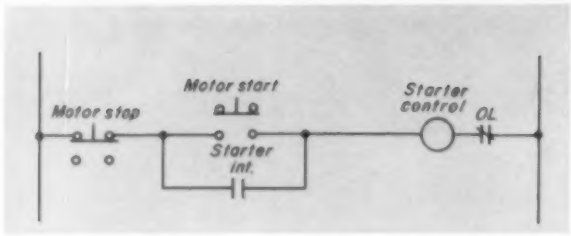
AUTOMATIC AIR BLEED-OFF VALVE allows free air flow to tank, purging the system. Air pressure against the spring-loaded poppet is not high enough to close it. First flow of hydraulic fluid closes poppet and system pressure then holds it closed.

through the valve. System load varies only about 5 to 8%, so the flow control valves need to be effective only throughout this small range.

• **Automatic bleed-off**—When no fluid motors are connected into the system, the pumps start against a blocked line. Automatic bleed-off valves purge the system of air so the pumps can prime. Without them, air in the pump and outlet line could not be compressed enough to be expelled through the relief valve, and the pump could not prime. When all air has been bled off, the first surge of oil through the bleed-off valve closes it, and it remains closed during the remaining operation of the system. □□□

Motor control

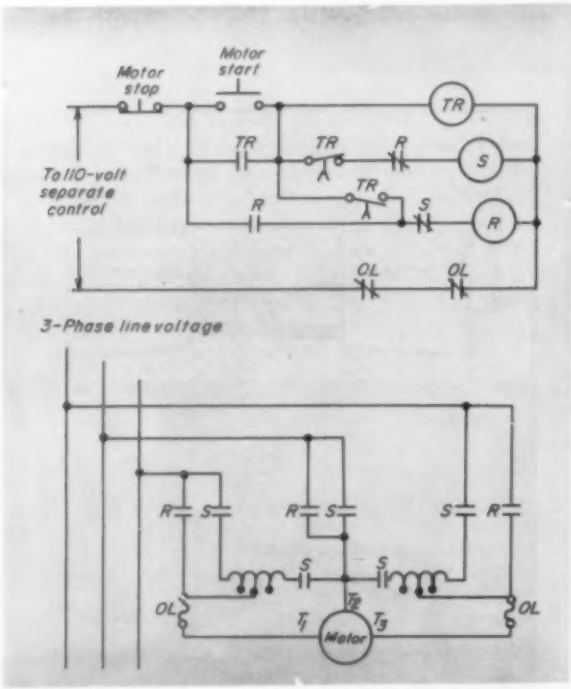
• By KENNETH B. REXFORD,



FULL VOLTAGE STARTER—Applying a single starter to a motor is usually not difficult. Normally a wiring diagram is supplied by the manufacturer of the starter.

Depressing the motor start button energizes the starter control coil. The starter interlock contact closes around the starter button, and the main contacts (not shown) close to connect the motor to the line.

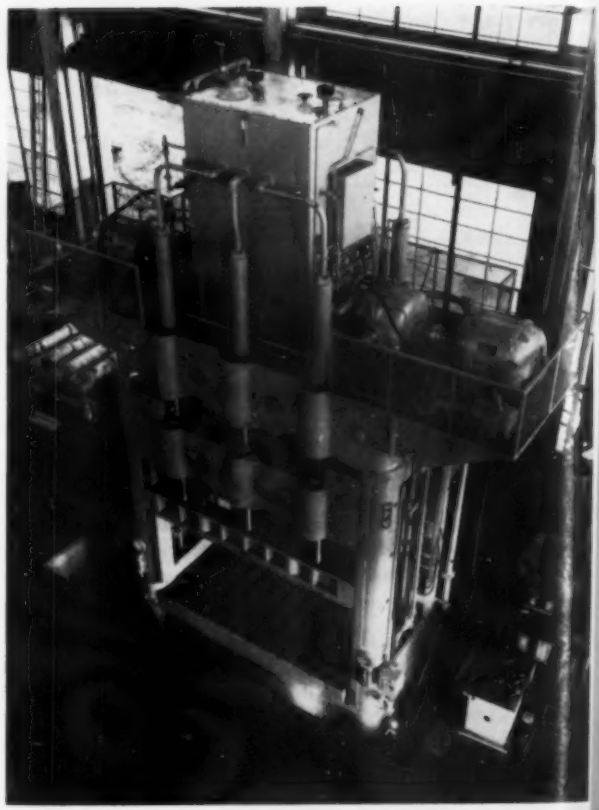
The motor is disconnected from the line by de-energizing the starter control coil by depressing the motor stop button or by opening the overload (OL) contact. This contact is operated by a thermal unit that senses excessive current over a prolonged period of time.



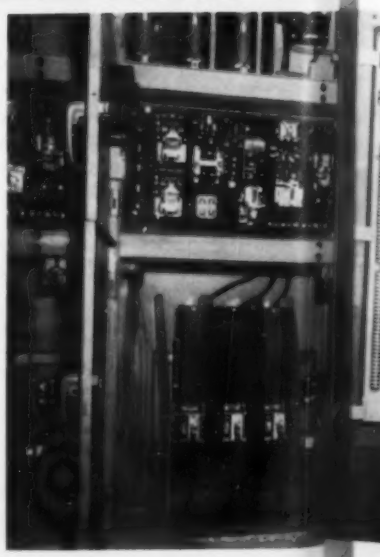
MAGNETIC REDUCED VOLTAGE STARTER—Depressing the motor start button energizes timer TR. This in turn interlocks around the start button and energizes the start contactor *S*, connecting reduced voltage to the motor.

After a time delay, while the motor comes up to nearly full speed, one set of normally closed timer contacts open, de-energizing start contactor *S* and removing the reduced voltage from the motor.

Other contacts on the timer now close, energizing the run contactor *R*. This connects the motor to the line at full voltage.



1000-TON BLANK HOLDER PRESS used in the aircraft industry has two main drive motors and auxiliary motors, each requiring a starter.

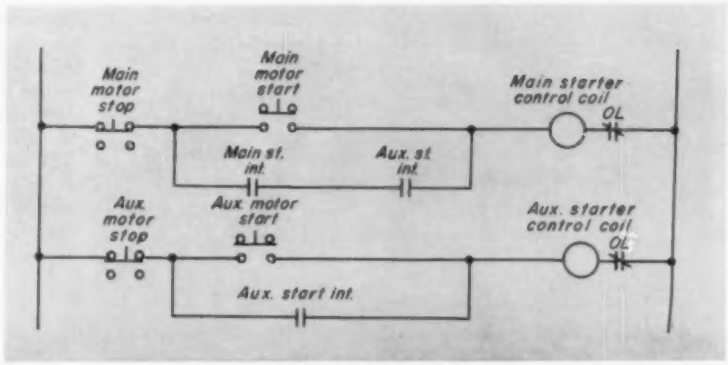


PARTS OF TWO, MAGNETIC REDUCED-VOLTAGE STARTERS are shown at left. Control cabinet with auxiliary motor starters is shown at right. Blank space is for additional handling equipment control. Relay control for the press cycle is at bottom of cabinet.

circuits for hydraulic presses

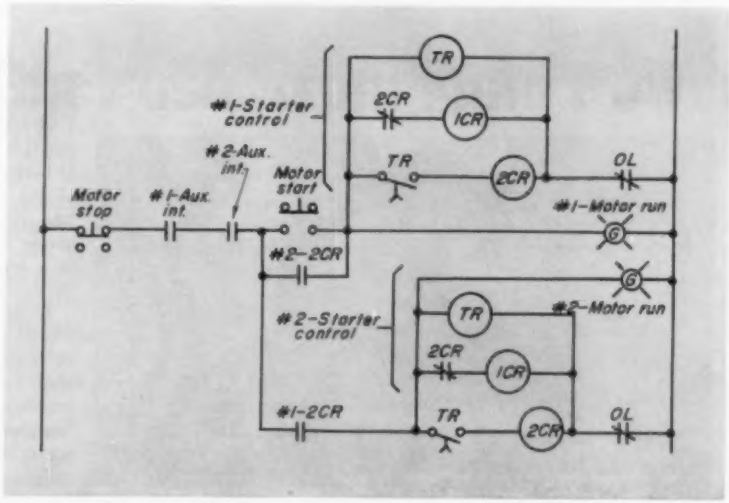
Chief Electrical Engineer, Hydraulic Press Mfg. Co., Division of Koehring Co., Mt. Gilead, Ohio

Selection of a motor starter depends on requirements for capacity, type (full or reduced voltage), enclosure, overload size, and ambient temperature. Here are circuit arrangements for starting and controlling motors which drive hydraulic pumps.



SEQUENCE STARTING—When a multiple of starters are used on a machine, problems of safety to operator or equipment, excessive line loading, and convenience may require sequence starting.

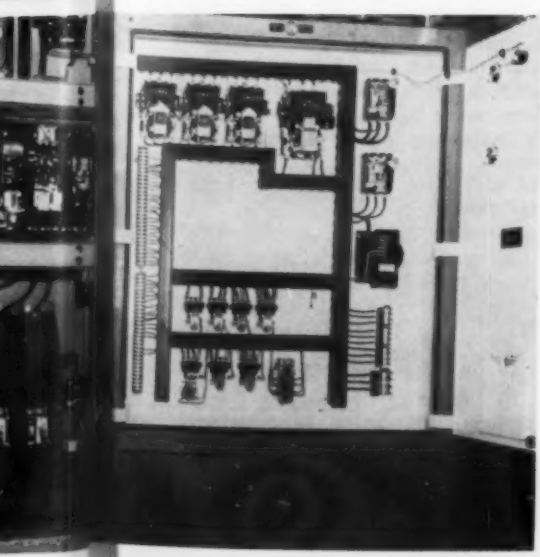
One of the motors drives the main hydraulic pump. An additional motor may be used for cooling or lubrication. It must start before the main motor. If the auxiliary motor drops out on overload, the main drive motor should also stop.

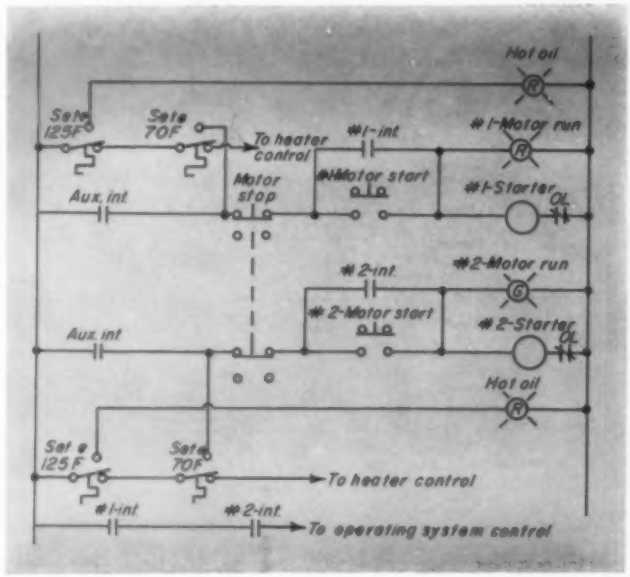


STARTING TWO MAIN DRIVE MOTORS—The two motors must start in sequence to relieve line inrush current. Both motors must be running before the start button can be released. The associated pilot supply or cooling motors must be started first and must also drop out the main motors in case either auxiliary motor drops out on overload.

When the auxiliary pumps have started, the No. 1 and No. 2 auxiliary contacts close. Depressing the motor start button energizes the control section of No. 1 starter. When the starter closes into full voltage condition, interlock No. 1-2CR closes and energizes the control section of No. 2 starter. When this starter closes into the full voltage condition, interlock No. 2-2CR closes and interlocks the start button.

Continued on next page



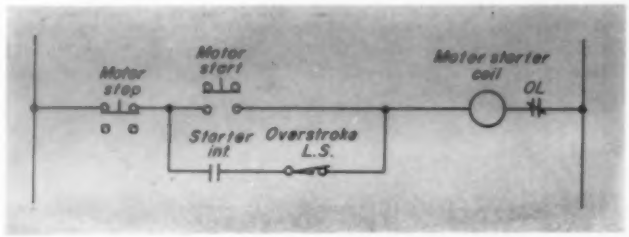


TEMPERATURE CONTROL — Oil temperature plays an important part in fluid power systems. Where systems are subjected to a wide range of ambient temperatures, the oil must be heated. The motors must not be started unless the oil is in the specified temperature range.

It is also important that the pumps do not operate with oil at excessive temperature.

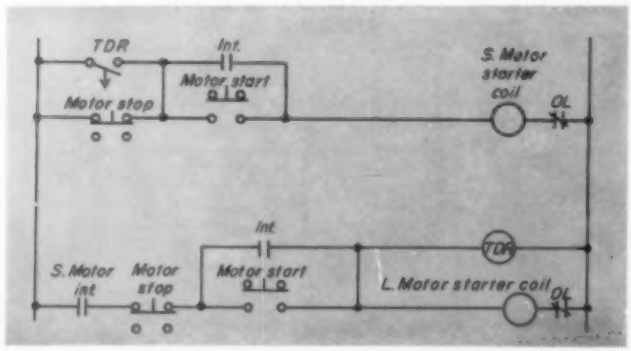
The two motors in this system can be started separately, but are stopped from one common pushbutton. In case the temperature control opens the motor control during a cycle, the motor must continue to run until the cycle is completed. If either motor goes out on over-temperature, the system operating control should be inoperative.

This system operates in the range of 70 to 125 F. The auxiliary interlocks are normally open, and close at the start of each cycle. They open at the completion of the cycle and do not close until the cycle is again started.



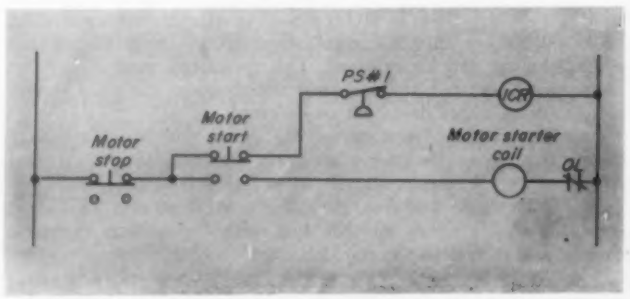
OVERSTROKE CONTROL—For safety, it is often necessary to provide an overstroke limit switch that cuts off power. The motor must then run on an emergency basis to back the cam off the limit switch.

After the cam has opened the motor circuit, the hydraulic circuit is switched to reverse, and the cam is backed off the overstroke switch by inching the motor start button.

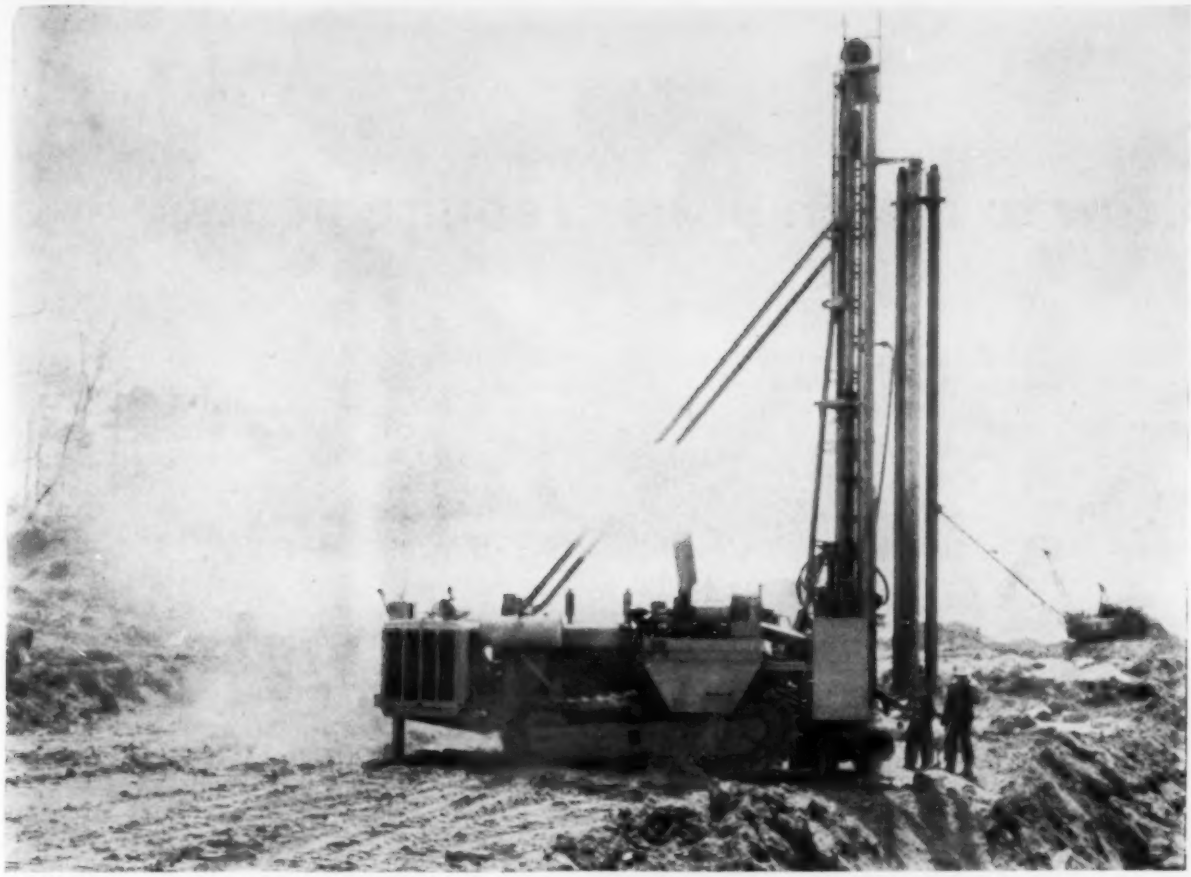


MAIN AND AUXILIARY MOTOR STOPPING—With a combination of a large main drive motor, (200-500 hp) and a small pilot system or cooling motor (10 hp), a problem of stopping may arise. If both are de-energized at the same time, the mass of the large rotor will keep it rotating, and the pump will continue to operate after the small motor and pump have stopped. This could result in a serious problem if pilot pressure and cooling must continue until the large pump stops.

In this circuit, a time delay has been used in the small motor circuit to keep it operating long enough to allow the large motor to stop. The small motor stop button is inoperative until the time delay contact has opened. This assumes normal operating conditions with power available to keep the small motor energized.



STARTING WITH LIGHT LOAD—In a fluid power system using an accumulator, it may be necessary to start the motor without the immediate charging load. By connecting the charging system control relay through the normally closed contacts of the motor start button, this part of the circuit is isolated when the button is depressed to start the motor. When the button is released, the charging circuit is energized, and the pressure builds to the setting of PS-1. □□□



New Drill Gets "Big Push" from Fluid Power

. . . COMMERCIAL Mobile Equipment Cylinders Stand Up in Exceptional Feet-Drilled-Per-Day Workout

The Robbins Rotary Blasthole Drill mounted on large crawler tractors is helping mine operators and highway contractors show substantial savings in drilling and blasting costs.

How? . . . by drilling larger-diameter holes on wider spacings, obtaining faster penetration rates and using low-cost explosives.

Two double-acting 159" stroke COMMERCIAL cylinders exert up to 60,000 lbs. down-pressure on the drill bit . . . penetrating soft ground up to 12 fpm—blue sandstone up to 2 fpm. The holes range from 6⅝" to 10⅝" in diameter. Three more COMMERCIAL hydraulic cylinders are used as jacks on the Robbins Drill to level the entire unit on grades up to 15%.

A. D. McElwain, drilling supervisor, C. F. Replogle Co., Circleville, Ohio, says, "We've used an RR-10 on heavy highway projects for over a year. There's no comparison in the quality O.E.M. components used, low maintenance and feet-drilled-per-day. The COMMERCIAL cylinders are trouble-free and smooth operating. Their rugged, yet compact design nicely balances this very efficient drill."

COMMERCIAL hydraulic cylinders are expressly engineered and manufactured to meet highest quality O.E.M. requirements. Low friction, self-adjusting packings prevent leaking and possible field failure by maintaining a high pressure seal between piston rod and stuffing box. Cylinder tubing, precision bored and honed in seamless steel, and piston rods of cold rolled, ground and polished steel give assurance that COMMERCIAL cylinders will continue to operate free of distortion and erratic extension.

COMMERCIAL has never made a "cheap" hydraulic cylinder. Yet, COMMERCIAL engineers can prove that *quality cylinders that protect your product's quality* are the most economical. For the whole story on how fluid power may add important sales advantages to your product, just write to Dept. A-31.

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HYDRAULIC CYLINDERS

PROBLEMS & ANSWERS

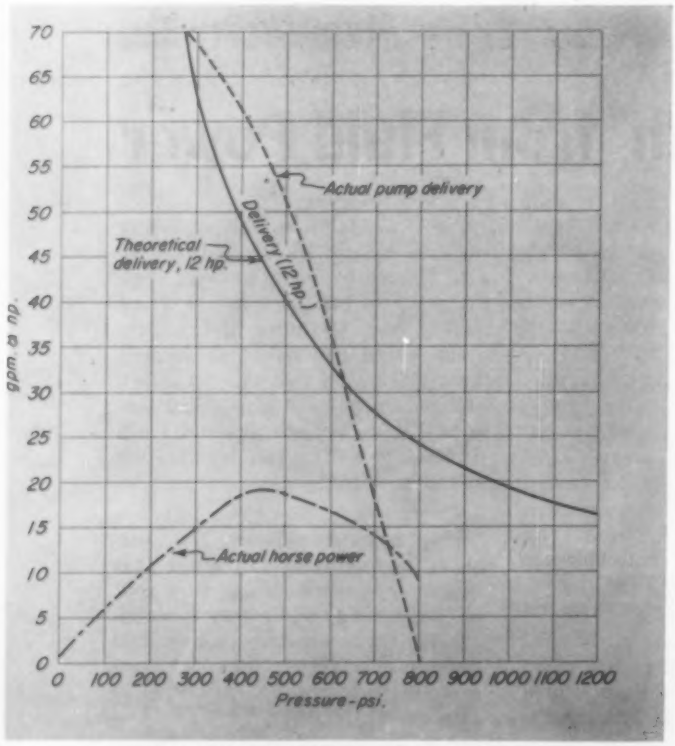
• By ELMER F. HEISER, *Precision Products, Inc., Cleveland, Ohio*

How to match power requirements

PROBLEM—To design a hydraulic system for a special purpose, long stroke press with these specifications:

- *Total stroke, 42 in.*
- *Approach stroke at 250 psi, 24 in.*
- *Work stroke, 18 in. During work stroke, resistance rises, and pressure increases from 250 to 700 psi.*
- *Final clamping. At the end of the work stroke, the press must hold at 1250 psi for 4 to 5 minutes.*
- *Maximum horsepower available to drive the pump, 15 hp.*

ANSWER—Before making any selection of hydraulic equipment, we plotted the ideal curve of pump flow vs. pressure for 12 hp. This represents output from the pump with 15-hp input at 80% efficiency. It was advisable to supply the maximum possible volume throughout the 18-in. work stroke, not only to have the most efficient system, but because of the nature of the operation. The curve shows that 65 gpm can be delivered at 300 psi, 48 gpm at 400 psi, 42 gpm at 500 psi, 33 gpm at 600 psi and 27 gpm at 700 psi, without exceeding 12 hp. The work stroke is completed when system pressure reaches 700 psi. A small volume is required to raise the pressure from 700 psi to 1250 psi, which is the final holding pressure. But during the holding period, only a very small amount of oil at pressure is required to replace leakage. The horsepower required for the final pressure increase is considerably under the maximum 15 hp allowed for closing.

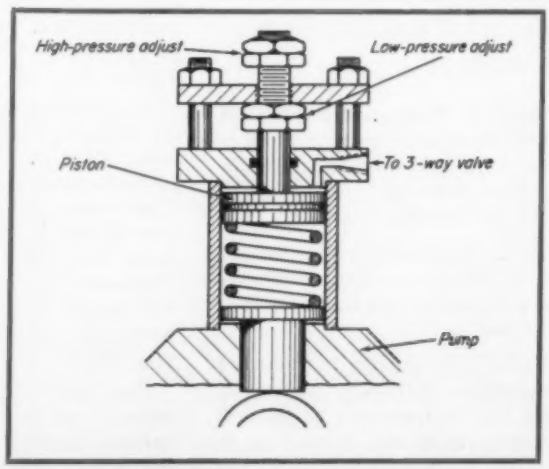


WITH 15 HP AVAILABLE to drive the pump, which is assumed to be 80% efficient, solid line shows theoretical pump flow with increasing pressure. Dashed line at top shows how pressure compensated pump matches the ideal flow-pressure curve.

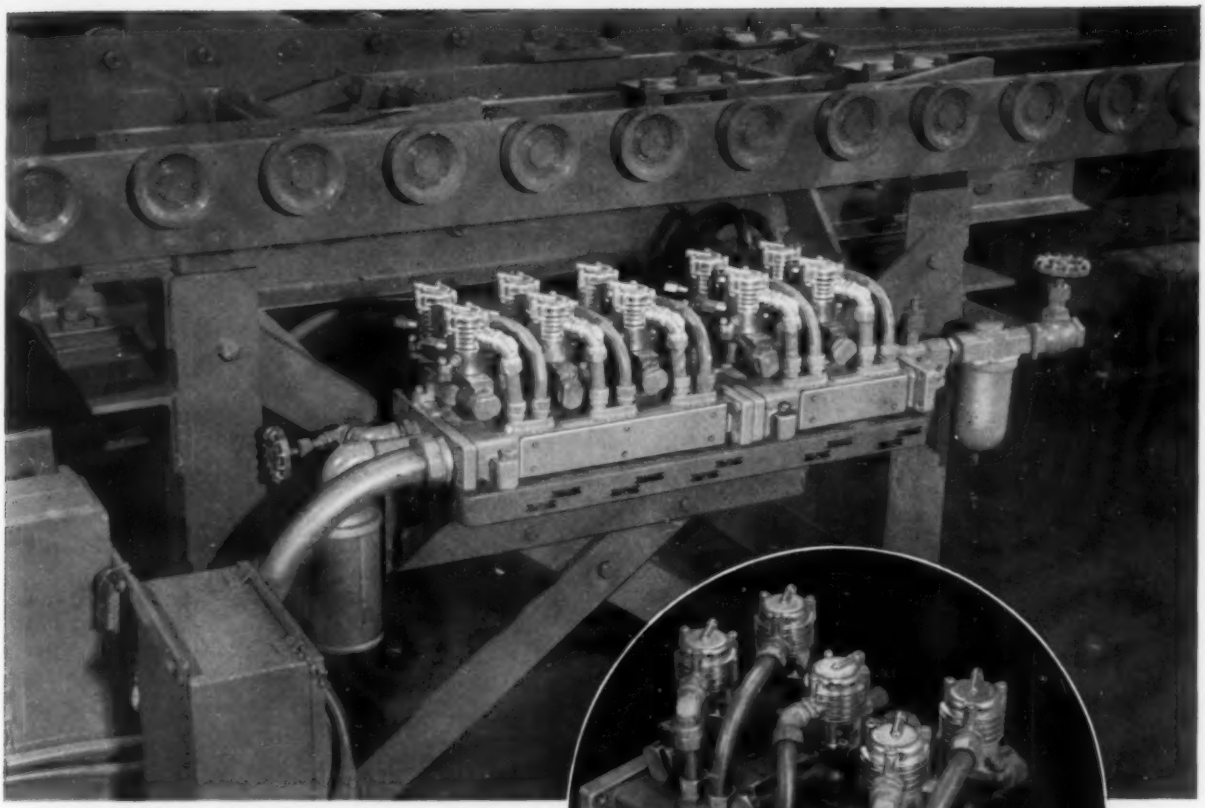
• **Matching the curve**—This looked like an ideal application for a pressure compensated, variable volume pump, if the pump control could match or approach the ideal curve. We found that a vane type pump with a spring type governor control had a delivery as shown on the dashed line. Although this does not exactly parallel the ideal curve, it does approach it very closely, so that this pump control offered advantages over any combination of constant displacement pumps.

The manufacturer's horsepower curve for the particular pump and control is shown on the dashed

Continued on page 82



SPECIAL PUMP CONTROL gives two spring forces on the hydraulically loaded vane ring. This sets deadhead pressure of pressure compensated pump. Stop nuts adjust piston position when pressure is applied to or released from piston.



This bank of manifold-mounted Speed King valves controls a foundry mold flask indexing unit, custom-built for a major automotive manufacturer.

to simplify piping and wiring of complex control valve installations, use...

VALVAIR'S NEW SPEED KING® MANIFOLDS

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VALVES — 2 or 3 stations for ⅜-¾ in. NPT standard Speed King or ¼ in. NPT plug-in Speed King Valves, single or double solenoid, 2, 3 or 4-way. Remote operated, speed controlled* and power-centered neutral* valves may be used in any number and combination.

PIPING — Intake and exhaust ports common to all stations. Pipe threads, both ends, and O-ring grooves.

PORTING — Optional size cylinder ports. Side and bottom outlets, flush pipe plugs.

WIRING — Large conduit passage, with side access cover, common to all stations. Pipe threads, both ends, and O-ring grooves. Pilot leads (standard Speed King valves) encased in flexible conduit, integral pilot connections for ¼ in. NPT plug-in Speed Kings.

MOUNTING — 2 mounting points per manifold. For ganging, kits of O-rings and through bolts are offered.

**Standard Speed King valves only.*

Easier in-use service is another benefit! Individual pilots, valves or entire manifolds are replaceable as units to minimize machine downtime.

And, Speed King manifolds *are available for immediate delivery from stock.* Before you engineer new equipment or up-grade machines now in service, investigate the design and cost advantages of Valvair Speed King manifolds.

For more information, write for Bulletin D-58. Address Dept. AH859, Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.

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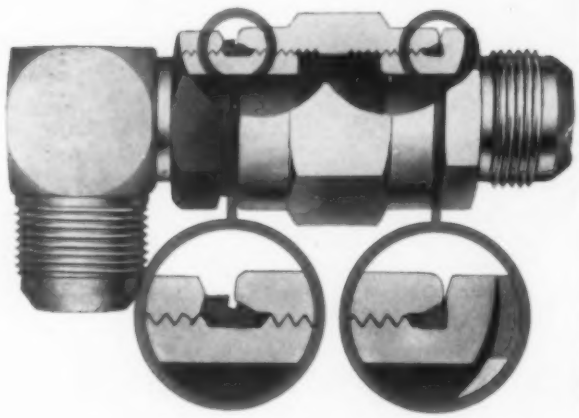

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line at the bottom. It shows that maximum horsepower of 18 hp is required at approximately 450 psi. This is a 20% overload, but since the pump is at this pressure only a very short time in the overall cycle, it is acceptable. At the 700-psi point, the ideal delivery curve shows that 27 gpm should be available at 12 hp. However, the actual pump curve shows only about 18-gpm output. The difference is caused partly by errors in developing the curves, and partly by pump slip at the higher pressures.

• **High pressure holding**—The pump with the characteristics shown seemed ideally suited for the major requirement of fastest closing speed throughout the 18-in. work stroke. However a secondary, but very important problem, was obtaining and holding the higher final pressure during the extended time period. The pump delivery curve shows that approximately 9 hp is required to deadhead the pump at zero displacement at 800 psi. The advantage gained by using this pump for its relative efficiency during the closing stroke could be lost if we had to either use it for holding at the higher pressure, or unload its large

This article begins a series from the files of a "fluid power tailor shop". Precision Products, Inc. works on fluid power problems which cannot be met by standard components. Here is an example of how they modified equipment to suit a special requirement.

volume at zero pressure during the holding position of the cycle, and add a small volume, holding pump to the system.

However, the manufacturer's horsepower curve also shows that the same large pump which requires 9 hp to deadhead at 800 psi, deadheads at 250 psi with approximately 2.5 hp. A simple 5:1 booster, operating with a 250-psi input from the pump could answer the problem of holding pressure with low horsepower during the long curing period.

• **Special pump control**—To take advantage of the pump characteristics at the two different pressures, we could not use a standard control for the pump. However, we reasoned that by using the control spring supplied with the pump, we required only a way to change the control spring setting quickly.

Our answer to the pump control problem is shown in the diagram. Instead of a conventional adjusting screw to vary the spring loading, we installed a piston with externally adjustable stops. When oil is admitted to the control during approach and work stroke, the piston moves down to the pre-set stop, and the pump delivers according to the dashed curve. When the pump control piston is connected to tank during holding, the spring loading is reduced, and the pump deadheads at 250 psi.

A small solenoid valve controls this two-pressure pump. It is actuated by a pressure switch which senses 700-psi pressure. The small 3-way valve then drains the control piston and the pump drops to low pressure setting to hold through the booster. □□□

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Life expectancy is many millions of cycles and by renewing the one-piece valve plunger, many millions more can be expected. The plunger can be replaced without disturbing rigid piping.

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	TWO-WAY	THREE-WAY
CATALOG NO.	91011	91011
PRESSURE RANGE	1/16" ORIFICE: 0-500 PSI 3/16" ORIFICE: 0- 70 PSI	1/16" ORIFICE: 0-300 PSI 3/16" ORIFICE: 0-100 PSI
ORIFICES	1/16" THROUGH 3/16"	1/16" AND 3/16"
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
POWER CONSUMPTION	10 - 20 WATTS	10 - 20 WATTS
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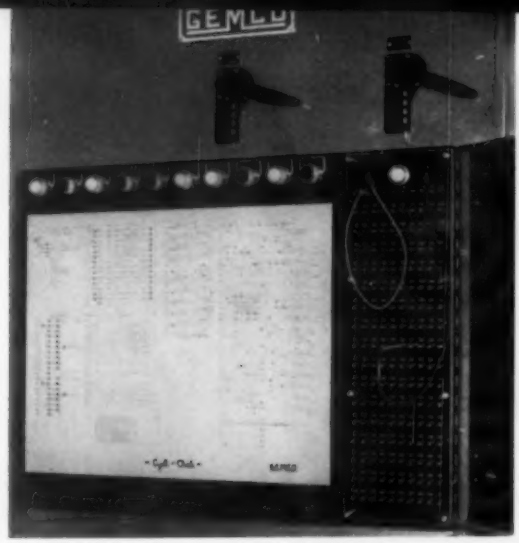
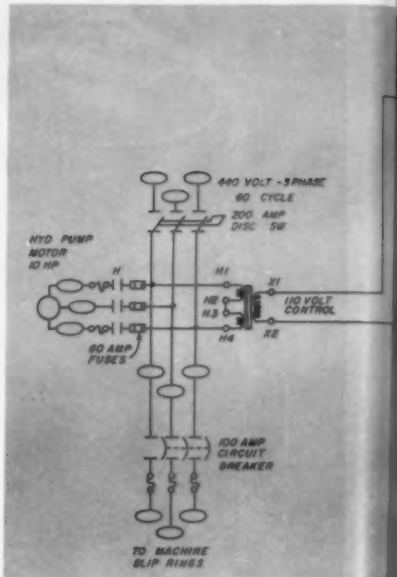
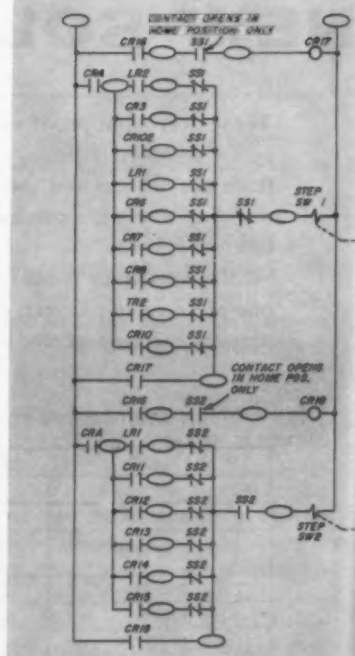






Electrical design to cut maintenance

• By V. SPAGNUOLO, *Chief Engineer, Gemco Electric Co., Detroit, Michigan.*

BY PROVIDING numerous voltage check points and designing a system of indicating lights, engineers at Gemco Electric have come up with an electrical control system to speed maintenance.

These features are incorporated on an index type foundry machine for blowing cores used in centrifugal casting of auto brake drums. Like every high production operation, downtime is extremely expensive. Because of dirt in the foundry, maintenance can be especially troublesome. Maintenance features to find trouble fast or to prevent them altogether, have resulted in less replacements and higher production.

• **Circuit features**—Voltage check points to check each relay coil and contact, solenoid, limit switch, timer contact, and pushbutton are wired to a jack board mounted with a circuit diagram on the electrical control enclosure. Using a probe and light which are provided, the maintenance technician can quickly locate faulty components when the machine fails.

To guide him to the approximate part of the circuit which is faulty, lights are installed with the circuit diagram to indicate the next operation in the machine sequence. If the machine fails, the lights tell what should have happened next. The technician can then check voltages to determine why it didn't.

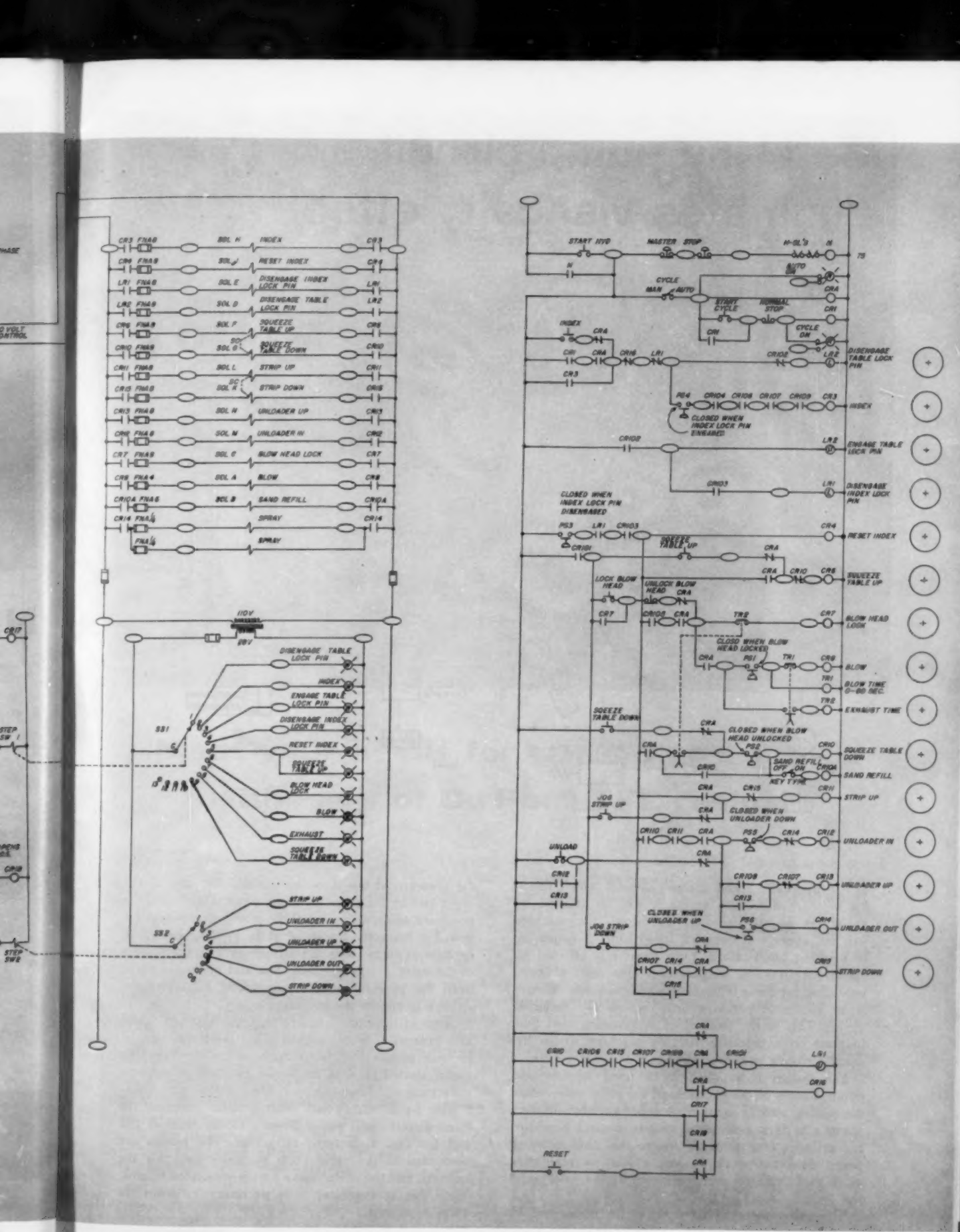
The lights are energized by a stepping switch which is sequenced by machine operation.

• **Component features**—Each solenoid valve is fused to prevent solenoid burnout. The fuses pass normal solenoid inrush current but blow when an overcurrent lasts too long, as when a valve jams. The fuses blow instantly on a very high overcurrent such as a short circuit. This cuts downtime because a fuse is easier to replace than a valve solenoid.

Relays used throughout the electrical control system have sealed contacts, because of the dirty atmosphere in a foundry.

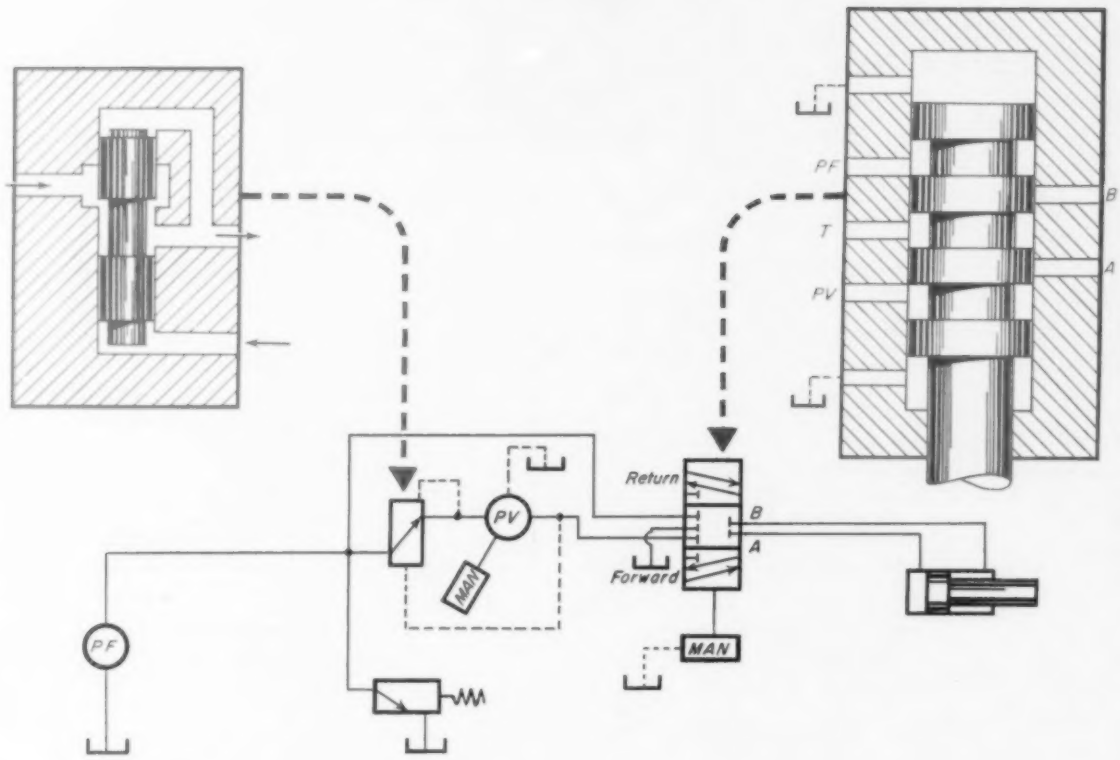
Latching relays are used in the index table circuit to prevent the system from getting out of sequence in case of power failure. A single-solenoid valve controls the table lock pin. In the spring-loaded position of this valve, it directs fluid to an actuating cylinder forcing the pin in. If electrical power is lost during indexing, the valve shifts to its spring-loaded position forcing the pin in. The use of a latching relay insures that the pin will retract after power is reapplied.

The stepping switch is a telephone type which advances when a signal is applied to its solenoid and then broken. Because the switch has one contact in each circuit which it monitors, it can *find itself* if the machine is operated manually. That is, the switch steps to the position corresponding to the actual machine position. Designing the switch into a plug-in, sealed package gives it maximum protection from a dirty environment and makes it easy to maintain or replace. □□□


INDEX
RESET INDEX
DISENGAGE INDEX LOCK PIN
DISENGAGE TABLE LOCK PIN
SQUEEZE TABLE UP
SQUEEZE TABLE DOWN
STRIP UP
STRIP DOWN
UNLOADER UP
UNLOADER IN
BLOW HEAD LOCK
BLOW
SAND REFILL
SPRAY
START HYD
MASTER STOP
CYCLE
MAN
AUTO
START CYCLE
NORMAL STOP
CYCLE ON
ENGAGE TABLE LOCK PIN
CLOSED WHEN INDEX LOCK PIN ENGAGED
CLOSED WHEN INDEX LOCK PIN DISENGAGED
LOCK BLOW HEAD
UNLOCK BLOW HEAD
CLOSED WHEN BLOW HEAD LOCKED
BLOW TIME 0-60 SEC.
EXHAUST TIME
CLOSED WHEN BLOW HEAD UNLOCKED
KEY TYPE
JOG STRIP UP
CLOSED WHEN UNLOADER DOWN
UNLOAD
CLOSED WHEN UNLOADER UP
JOG STRIP DOWN
UNLOADER OUT
RESET

Metering pump circuit eliminates viscosity effect

• By J. R. FAWCETT



ANY hydraulic speed control element which has a pressure difference across it will be affected by variations in oil viscosity. Therefore, the machine will not operate at constant speed until it comes up to working temperature. Even then it is affected by variations in shop temperature. One way of compensating for these temperature and viscosity changes is to eliminate pressure drop across the metering device. This is the method of overcoming feed fluctuations on a precision turning machine whose hydraulic circuit is shown above.

The system is supplied by a fixed displacement pump. Excess oil passes through the relief valve while the cutting feed is engaged. A small variable delivery pump acts as a metering device to control flow during cylinder extension. To insure that this metering pump does not work against a load, a regulating valve maintains the same pressure at the inlet as at the outlet.

The valve piston is acted on at the upper end by the pressure at the metering pump inlet, and at the lower end by the pressure at the pump outlet. If these pressures are not the same, the piston moves to alter flow. For instance, if pressure at the cylinder increases, because of an increase in load, pressure on the bottom of the valve piston also increases and opens the valve until the pressure at the pump inlet has increased enough to restore the balance.

Stops at the end of the valve piston limit its travel and prevent it from closing fully. However, even if it were completely closed, as soon as the metering pump started, the pump would produce a pressure difference which would open the valve.

The 5-port directional control valve connects the fixed displacement pump directly to the cylinder rod end for fast un-metered retraction. The pumps are connected to the valve ports normally used for the exhaust, and the center valve port is connected to tank. With this arrangement it is necessary to drain the valve as shown. □□□

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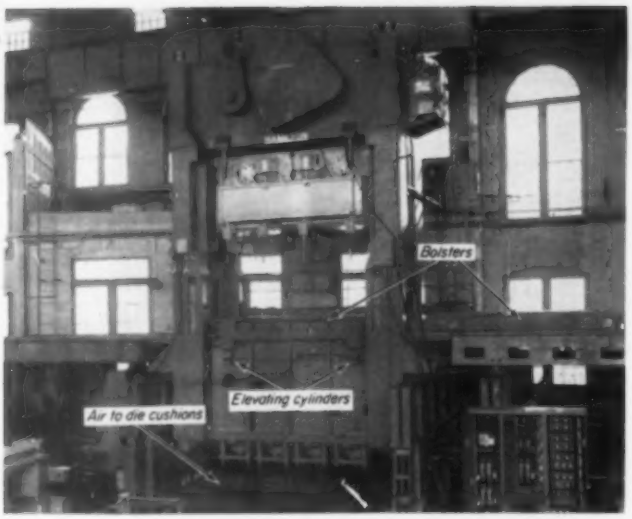
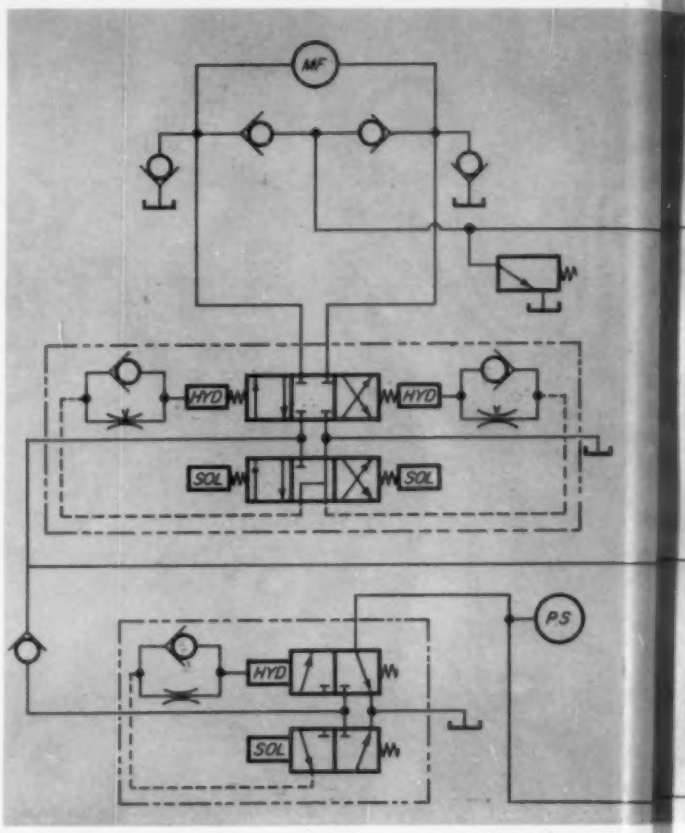


DIES ARE ATTACHED TO SLIDING BOLSTERS on this forming press. Left bolster is shown in place under the press platen. To remove the dies, the bolster moves left to clear the press. New dies are placed on the right bolster and it slides into position under the press ram. Elevating cylinders raise the bolsters clear of the keys in the press bed.



Saving air with pneumatic die cushions

• By DON W. SMITH, *Engineer, Baldwin-Lima-Hamilton Corp., Hamilton, Ohio*

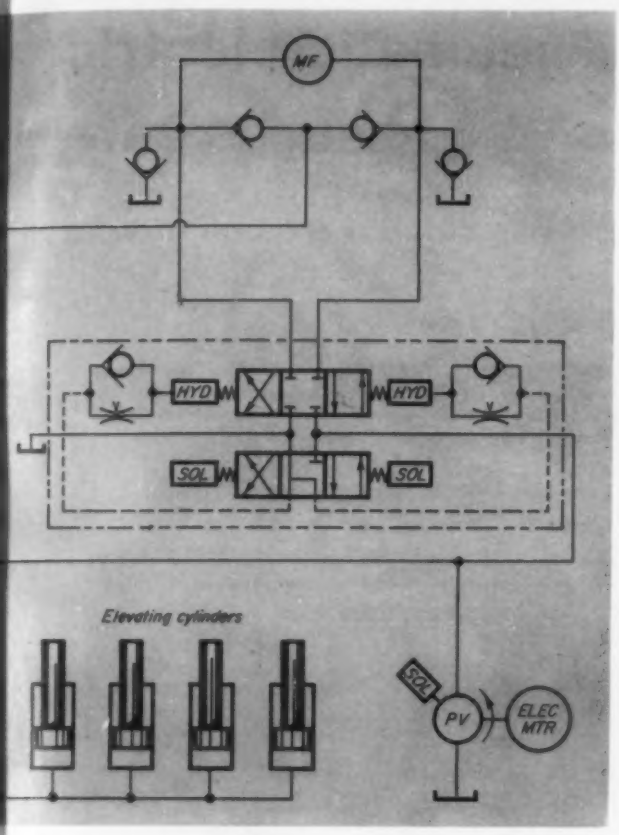
Dies can be changed fast on a sliding bolster press, but if the air must be exhausted from the die cushion surge tanks to retract the cushions, the time saving is lost. Here's a way to retract the cushions and retain air pressure in the surge tank.

WITH a conventional hydraulic press the dies are loaded directly onto the press bed. This requires an overhead crane and a lift truck to position the die under the ram. Here's a press with a sliding bolster on each side of the bed. An overhead crane places the die on the bolster which then slides into position under the press platen.

Die cushions must extend through the bolsters while the press is operating, and retract into the press bed when the bolster moves. Air cylinders raise and lower the die cushions.

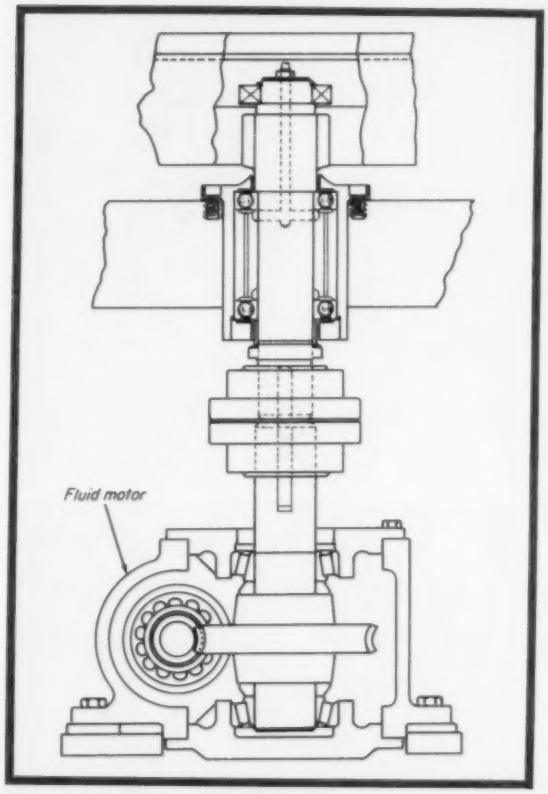
• **Die cushions**—Each of the air-loaded die cushions has an integral surge tank. This tank stores a large volume of air to give uniform cushioning to the die cushion cylinders. Before the bolster moves to change dies, the cushions must fully retract. If the cylinders exhaust while open to the surge tank, all of the air in the tank is lost. To conserve this air a special valve and cylinder raises and lowers the cushions without exhausting the surge tank. A 3-way solenoid valve raises and lowers the cushion cylinders. A 4-way valve operates an air-pilot valve which closes and traps air in the surge tank.

• **Bolster drive**—The hydraulic circuit for the

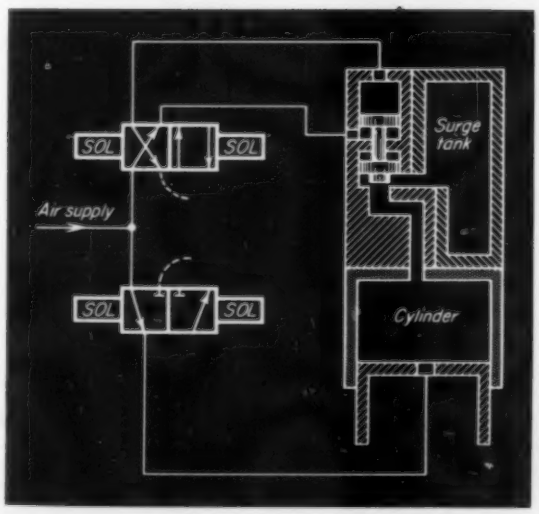


BOLSTER DRIVE CIRCUIT has one relief valve to protect both hydraulic motors from overpressure in either direction. A line to the reservoir from each side of the fluid motors furnishes makeup oil when the motors overrun. A check valve in the line to the elevating cylinders' control valve keeps the cylinders extended when pump volume drops to zero.

A pressure switch prevents the bolsters from moving until they are elevated above the keys in the press bed.



HYDRAULIC MOTOR DRIVES A RACK through reduction gears to move the bolster back and forth. This gear reduction provides high force to drive the bolster.



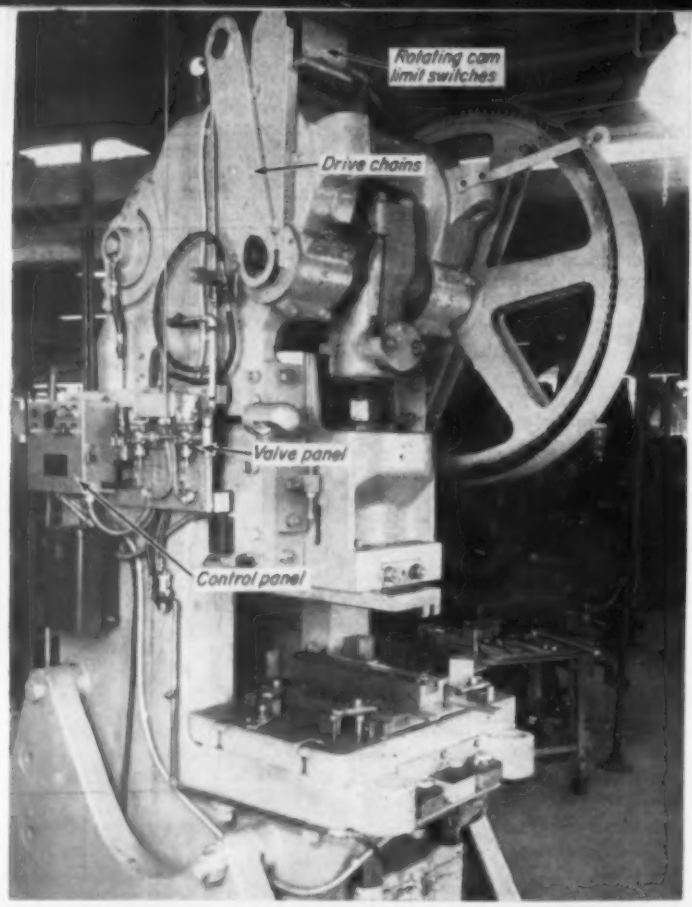
SINGLE-ACTING CYLINDER incorporating a surge tank and a 2-way valve raises and lowers each die cushion. Air in the surge tank is trapped when the cylinder retracts. Valves are shown in the press operating position. To lower the cushion, the 4-way valve shifts and directs air pressure to close the surge tank valve. A timer times out to shift the 3-way valve, exhausting the cylinder. The cushion retracts.

bolster is separate from the main press circuit. A 1000-psi, 16-gpm, variable-displacement pump supplies power for the bolsters.

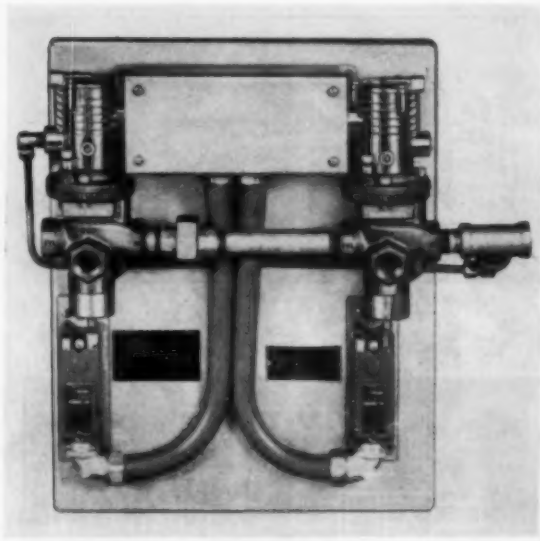
To move the bolster clear of the press, four single-acting cylinders raise it off the keys in the press bed. The bolster then moves right or left at high speed. As it approaches its stop position, a limit switch actuates a solenoid on the pump and decreases pump flow. The bolster moves slowly into its stop. It is then in position to replace the die. □□□

Pneumatic-electric assures safe

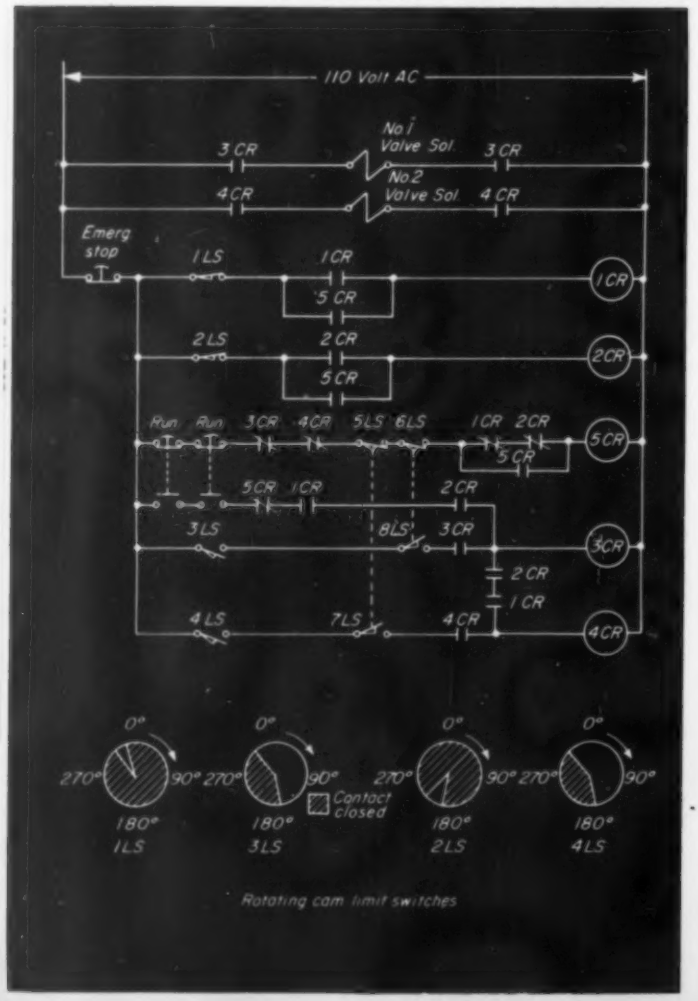
• By GEORGE M. COON,



TWO SEPARATELY-GUARDED CHAINS drive rotary limit switches. If one chain breaks, it can't tangle with the other. Both limit switches must operate to cycle the press. Electrical controls and relays are in a locked enclosure.



AIR VALVE PANEL has two, pilot-operated solenoid valves in series. Air to the clutch and brake pass through both valves. Valve stems extend through the body and actuate limit switches. If either valve is not closed when the operator presses the run buttons, the press will not cycle.



ELECTRICAL CIRCUIT with power off and the press ram at the top of its stroke. All relays are de-energized and the solenoid valves closed with their pushrods down. Power to the circuit energizes relay 5 CR which in turn energizes anti-repeat relays 1 CR and 2 CR.

To start a cycle, the RUN buttons are depressed, de-energizing 5 CR and energizing 3 CR and 4 CR. This energizes both 3-way solenoid valves, directing air to the clutch. Pressure to the clutch rotates the press crankshaft. When the valves shift, their stems lift and close limit switches 7 LS and 8 LS.

The RUN pushbuttons are released near the bottom of the stroke, and limit switches 3 LS and 4 LS close forming a closed circuit for CR 3 and CR 4. Press operates automatically for the rest of the cycle.

As the crankshaft rotates, 2 LS opens at about 210 degrees de-energizing relay 2 CR. At about 300 degrees, 1 LS opens

interlock press operation

President, Textrol, Inc., Cleveland, Ohio

Valve stem extensions actuate limit switches to interlock the electrical and pneumatic systems in this press safety system. Dual control systems prevent the press from cycling if a component fails.

MECHANICAL presses generally use an air clutch to engage the ram crankshaft and an air released spring set brake to stop the press. Malfunction of an air control component could direct air to the clutch before the operator calls for it. If this happens, the press cycles without the operator expecting it. This could cause personal injury or damage to the work.

The conventional anti-repeat control uses one solenoid valve and relay, one cam-operated limit switch, and one anti-repeat relay. If any one of these components fails, the press could repeat. A variation of this circuit has two solenoid valves with their relays in parallel and their solenoid coils in series. This system is safer, but component failure could still cause the press to repeat.

• **Dual circuits**—In the Andrus-Coon press control system made by Textrol, the press is completely protected against cycling due to component failure. Two solenoid air valves and relays, two anti-repeat relays, and two separately driven rotary limit switches give this protection. Two entirely independent systems, isolated from each other, act to stop the press at the top of its stroke.

In a conventional 2-valve system the press operates on one valve, if the other is stuck open. If this occurs, the protection of dual valves is lost. Using limit switches to sense the position of the valve stems prevents starting a cycle if either of the valves is not in its proper position.

Each of the dual components is automatically monitored during the cycle. If any device fails to complete its normal function, the press stops. It can't be cycled again until the trouble is corrected.

Control panels are built to specifications including JIC standard industrial or plug-in relays. □ □ □

and de-energizes 1 CR. This isolates 3 CR and 4 CR relay circuits from each other.

The critical point in the cycle is when the ram reaches top dead center and must stop. At this point there are two separate electrical, pneumatic, and mechanical circuits operating. Either one will stop the ram at the top of its stroke.

At 330-degree crankshaft rotation, 3 LS and 4 LS open. Relays 3 CR and 4 CR are de-energized, and the solenoid valves shift. The clutch is released and the brakes applied. When the valves shift, 5 LS and 6 LS close and 7 LS and 8 LS open.

To start the next cycle, relay 5 CR must be energized through the contacts in its circuit. If any components haven't returned to normal, the 5 CR circuit will be open, and the next cycle won't start. Relay 5 CR is monitored by its normally-closed contacts.

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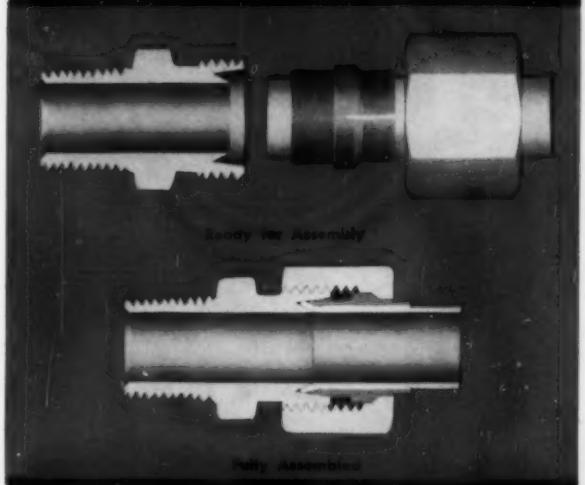

FLODAR'S Self-Flare Tube Fittings

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- Easy Assembly — Simply insert tube into fitting and tighten nut. "Rock Bottom" stop signals that joint is sealed.
- Double Seal — seals on both outside and inside of the tube.
- Lower Cost — FLODAR'S Self-Flare fittings cost less to buy and install.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

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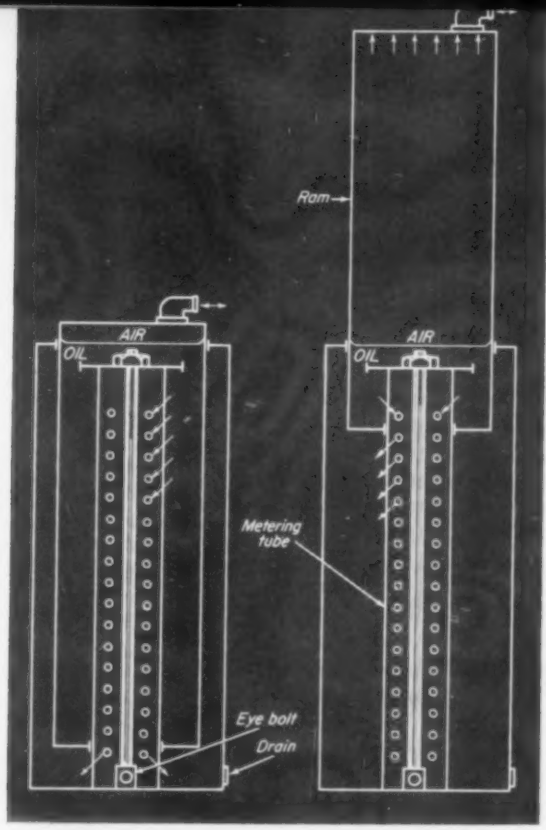
Circle **44** on *Time-Saver Card*

A HYDRAULIC RAM raises and lowers the pilot house on this tugboat. Ram is guided by a 26-in. long sleeve bearing. The long bearing is needed for support because there are no guide channels. Mast and radar antenna fold so that the top of the pilot house is the highest point above the water line.



OIL FLOWS through the orifices in the metering tube. Size and spacing of orifices determine rate of acceleration and deceleration.

Metering tube gives constant acceleration and deceleration

• By NORMAN RODEN, *The Roden Co., Cranford, N. J.*

RAISING and lowering the entire pilot house on a tugboat is done smoothly with a simple air/oil circuit that uses only one 3-way valve. A single-acting ram lifts the pilot house at constant acceleration for the first half-stroke and constant deceleration for the last half. No complicated valves are used. A simple metering tube designed into the cylinder controls the speed.

• **Metering**—To get the proper speed control, The Roden Co. designed the system with a special lifting cylinder. A drilled metering tube runs through the hollow plunger of the single-acting ram. The tube is fixed at the blank end of the cylinder and has a sliding seal where it goes through the bottom of the ram. To lift, air pressure is piped into the hollow ram and oil is forced out through the metering tube raising the ram. As holes are uncovered under the ram, more oil can escape and velocity increases at a constant rate. At mid-stroke, the number of holes above the seal for oil to enter the metering tube begin decreasing and the ram decelerates at a constant rate.

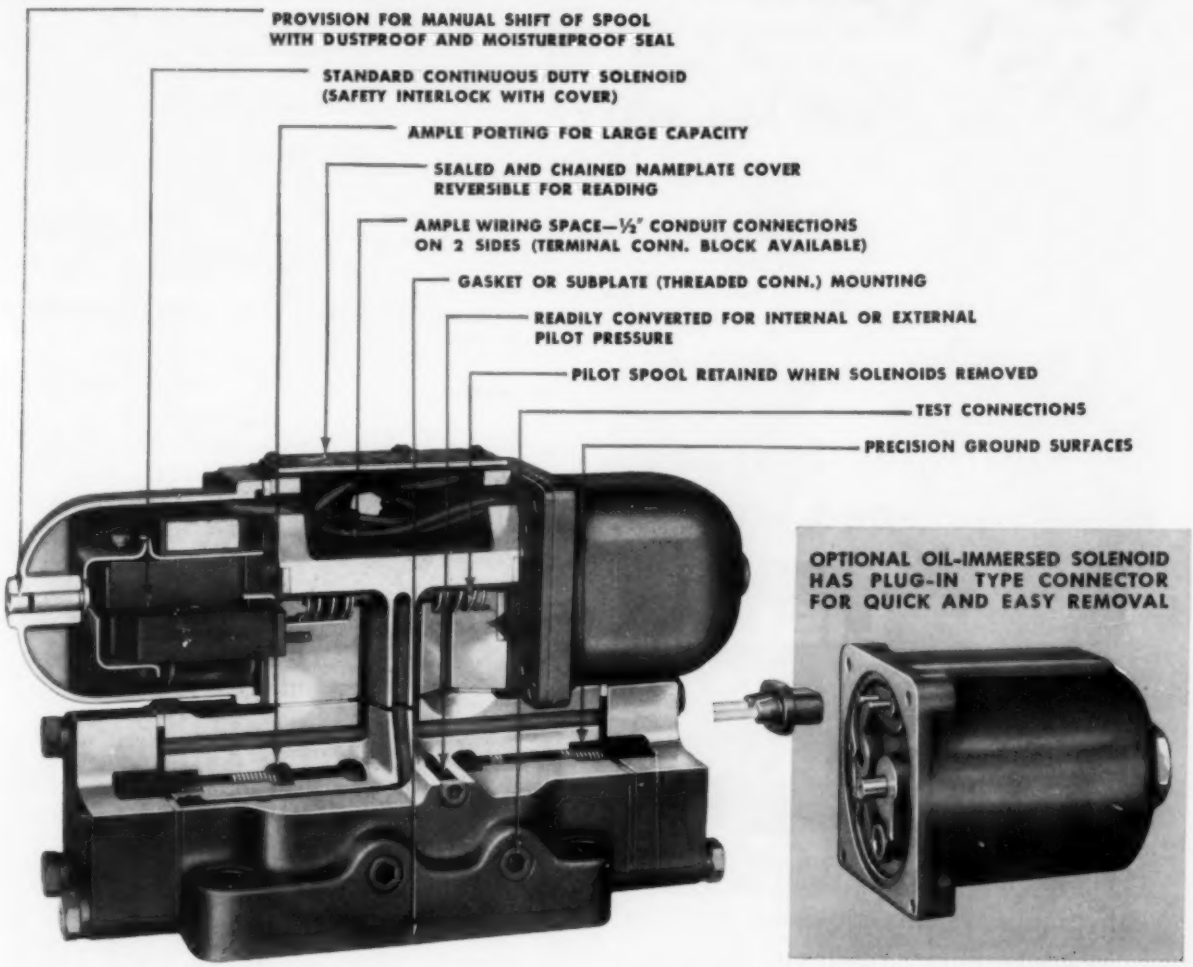
To lower, a manual 3-way valve exhausts the air and the action reverses.

• **Calculations**—The known values used to determine orifice size and spacing, and lifting pressure are:

Weight of pilot house	= 12,000 lbs
Diameter of ram	= 13.75 in.
Area of ram	= 148 sq in.
Rise	= 7 ft
Time	= 7 sec
Ram displacement	= 7.7 gal/ft

Continued on page 94

Only VICKERS® DIRECTIONAL VALVES Have *All* These Features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LONGER SOLENOID LIFE
LESS MAINTENANCE
EASIER INSTALLATION

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Seven spool types satisfy a wide variety of circuit needs and operate at pressures to 3000 psi. Optional oil-immersed solenoids operate cooler, increasing service life 20 to 30 times.

Installation is simplified with ease of wiring and a minimum of piping. The valves are available for gasket or sub-plate mounting. Mounting position is unrestricted except in "no-spring" models. The optional oil-immersed solenoid has a plug-in type connector and is available in all standard voltages. Field modification of existing units can be made to incorporate heavy-duty, oil-immersed solenoids.

The valves conform to JIC Standards and are available in ⅛" and ¼" direct solenoid operated models . . . ¾", 1¼", 2", and 3" solenoid controlled pilot operated models. These valves cover the flow range from 1.25 gpm to 320 gpm.

For further information, write for Installation Drawing I-182412.

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Circle **72** *on Time-Saver Card*

METERING TUBE

Assume constant acceleration for the first half of the stroke and constant deceleration, at the same rate, for the last half. Using the formula,

$$s = \frac{at^2}{2}$$

Where

$$s = 3.5 \text{ ft and } t = 3.5 \text{ sec}$$

we have,

$$3.5 = \frac{a(3.5)^2}{2}$$

or

$$a = \frac{2(3.5)}{(3.5)^2} = .57 \text{ ft/sec/sec}$$

To determine the velocity at mid-stroke use the formula,

$$v = at$$

substituting,

$$v = .57(3.5) = 1.995 \text{ ft/sec}$$

Solving for flow at mid-stroke gives;

$$Q = 1.995 \times 7.7 = 15.3 \text{ gps or } 2.05 \text{ cu ft/sec}$$

To determine the total orifice area required for the flow at mid-stroke, assume;
Specific gravity of oil,

$$s = 0.9$$

Pressure drop across orifice,

$$p = 40 \text{ psi or } 5770 \text{ lbs/sq ft}$$

Solving for the head in feet gives;

$$h = \frac{5770}{62.4 \times .9} = 103 \text{ ft}$$

Combining the formulas,

$$V = C\sqrt{2gh} \text{ and } Q = AV$$

where

A = orifice area, sq ft
Q = flow ,cu ft/sec
C = orifice coefficient, (0.76)
g = 32.2 ft/sec^2
h = head, ft

gives;

$$A = \frac{Q}{C\sqrt{2gh}}$$

$$A = \frac{2.05}{.76\sqrt{2} \times 32.2 \times 103}$$

$$A = .033 \text{ sq ft or } 4.77 \text{ sq in.}$$

Using ¼-in. holes having an area of .049 sq. in., the number of holes each side of the mid-point is,

$$N = \frac{4.77}{.049} = 97 \text{ holes}$$

The total number of holes in the ram is,

$$2 \times 97 = 194 \text{ holes}$$

In the final design 200 ¼-in. holes were evenly spaced on the tube.

Additional calculations showed that a pressure of 82.5 psi was needed to raise the pilot house with an acceleration of .57 ft/sec.^{2} Orifice size was calculated on the basis of a 40-psi pressure drop across the orifices. Adding 40-psi to the 82.5-psi gives 122.5

psi required to raise pilot house at .57 ft/sec.²

To find the volume of air consumed for each cycle, we used the formula,

$$V = A \times L \times \frac{P + 14.7}{14.7}$$

where,

V = cu ft of free air
A = piston area in sq ft
L = rise in ft
P = pressure in ram (psig)

Substituting,

$$V = 1.03 \times 7 \times \frac{122.5 + 14.7}{14.7} = 67.3 \text{ cu ft/cycle}$$

Using an 80 gal, (10.7 cu. ft.) receiver, with air stored at 250 psig, the pressure remaining in the tank after one cycle is calculated:

$$\text{Free air in the tank} = 10.7 \times \frac{250 + 14.7}{14.7} = 192.3 \text{ cu ft}$$

$192.3 - 67.3 = 125$ cu ft remain in receiver

Using Boyle's Law,

$$\frac{V_1}{V_2} = \frac{P_2}{P_1} \text{ or } P_2 = P_1 \times \frac{V_1}{V_2}$$

$$P_2 = 14.7 \times \frac{125}{10.7} = 172 \text{ psia}$$

$172 - 14.7 = 157.3$ psig in receiver after one cycle

With a compressor output of 15 cfm the recovery time for the receiver is $\frac{67.3}{15}$ or 4½ min. □□□

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LABOR & MATERIAL SAVINGS NO RETURN DRAIN PIPING (Sealed piston) MOUNTS WHERE CONVENIENT (Operates in any position, not sensitive to vibration)	UNSEALED PISTONS WHICH ADD TO YOUR INSTALLATION COST (return piping). ARE CRITICAL TO DIRT (pistons get stuck).

PRESSURE SWITCH DIVISION

Barksdale valves

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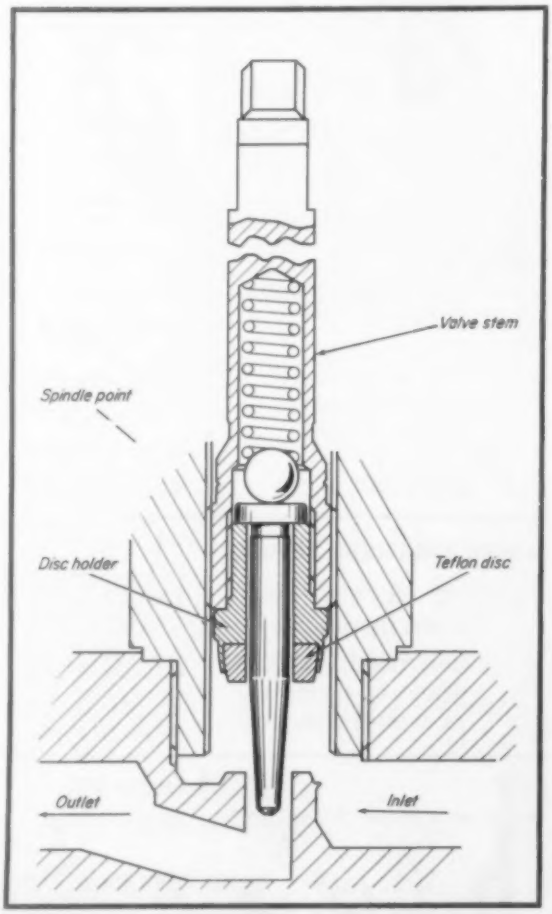
Circle **19** on Time-Saver Card

Spring loading prevents valve spindle galling

• By WALTER A. CALAHAN and FRANCIS C. HAYES
Design Engineers, Hoke Inc., Englewood, N. J.

WHEN designing a needle type metering valve for a wide temperature range at high pressures, care must be taken to avoid:

a. Galling of the spindle point in the orifice.
b. Orifice enlargement with repeated closings.
c. Binding, on entry of the spindle point into the orifice, using normal concentricity tolerances.

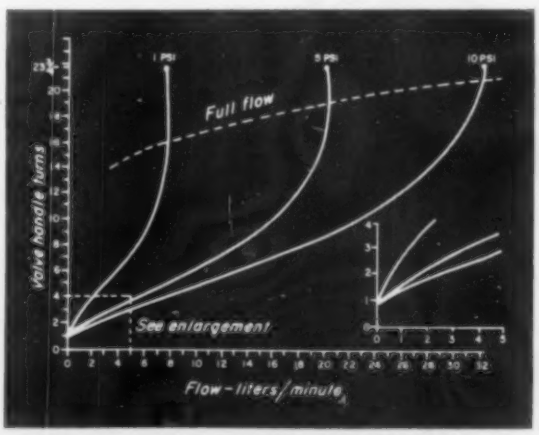


SECTION THROUGH VALVE showing stem assembly and the path of flow. Spindle point seats one turn before the Teflon disc bottoms.

For non-corrosive, —60F to 500F service, 316 stainless steel was selected for the valve metal parts. The spindle assembly consists of a stem with riser threads and a separate spindle point. This design prevents the spindle from rotating and galling, when seating in the orifice.

To prevent the orifice from being enlarged, metal-to-metal contact of spindle and seat was avoided by using a flat, Teflon disc in the stem assembly. Loaded by a coil spring, the spindle seated itself just one stem-turn ahead of the disc.

Reversing the normal flow pattern through the valve so that the fluid entered above the seat, insured that the Teflon disc would not be forced out of its holder by trapped pressures in the stem chamber when the valve is open. The pressure drop alone keeps the spindle point in its extreme position in the assembly until seated in the orifice. No spring compression is used for metering, from full flow to no flow. The low force compression spring is used only to overcome friction between the sides of the spindle point and its holder. The spindle point itself is self-centering in its orifice, insuring that it will not bind, no matter what the concentricity tolerances may be. □□□



FLOW CURVES for air pressure drop to atmosphere for a 316 stainless steel metering valve with a seat port diameter of 0.0625 inches.

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HYDRAULIC PRODUCTS DIVISION
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For complete details on Moog servoactuators write for Catalog 170.

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PRONER AIRPORT, EAST AURORA, NEW YORK

APPLIED **Hydraulics & Pneumatics**

AUGUST 1959

AVIATION SECTION

HOT FLUID TEST CHAMBER MOUNTS COMPONENTS ON PORTABLE WALL 100

By A. A. Meddock and E. J. Williams

New design approach to hot fluid test equipment demonstrates some novel hydraulic component applications.

AVIATION NEWS FROM THE FLUID POWER FIELD 105

AVIATION COMPONENT DATA 106

New products, services and literature of importance to designers of hydraulic and pneumatic systems for aircraft and missiles. For more information fill in and mail post card bound in this issue.

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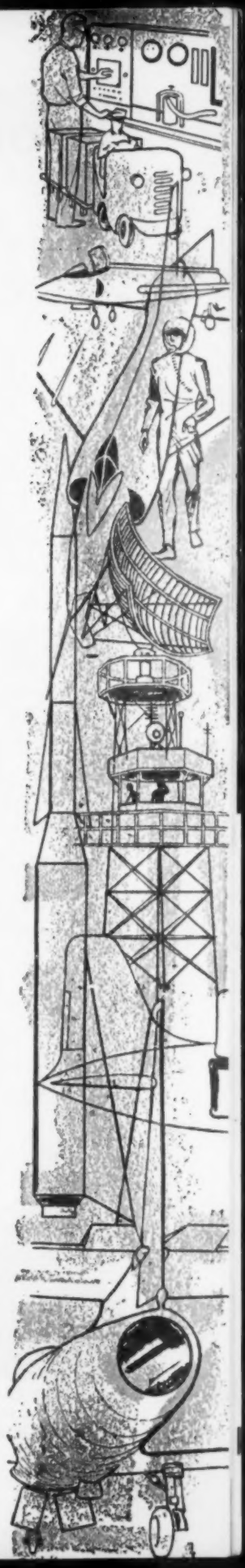
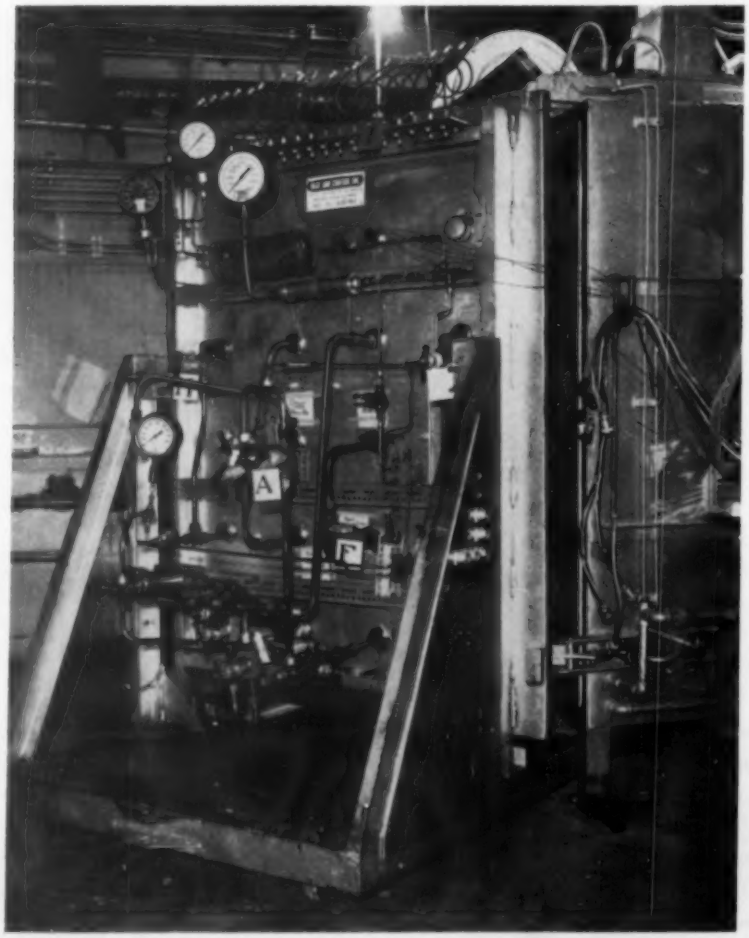


Hot fluid test chamber mounts components on a portable

• By A. A. MEDDOCK, *Supervisor* and E. J. WILLIAMS, *Assistant Supervisor*
Hydraulic Test Equipment, Pacific Div., Bendix Aviation Corp., North Hollywood, California

A new approach to environmental chamber design uses:

- ► A surge damper for 5,000 psi and 1,000 F operation
- ► Components mounted on a portable wall
- ► Leakage alarm lights



REMOVABLE CHAMBER WALL of test chamber mounts hydraulic components not subjected to high temperatures on its exterior side. Equipment on the wall may be inspected and checked while another unit is tested.

AIRCRAFT test facilities must meet these special requirements:

- 24-hour operation with minimum downtime
- Least possible hazard to operating personnel
- Easy access to equipment.

The Bendix environmental test chamber simulates hydraulic system temperatures in supersonic aircraft. Running for the past two years, it has been on a 16-hour a day schedule for over a year. The rig is capable of:

- —100 F to 1200 F ambient temperatures
- Fluid temperatures to 800 F
- Flows to 75 gpm
- Pressures to 5000 psi

ENVIRONMENTAL CHAMBER

One wall of the chamber is portable, riding on casters. Hydraulic components to be tested are mounted on its interior surface. While tests are going on, a second wall may be prepared and checked out, ready for use when the first test is over.

Connections for pressure pickups, hydraulic lines, temperature probes, etc. are made through 2" pipe port holes on the door. These holes also allow test equipment, not subject to heat test, to be installed on the external side. After the door is secured to the chamber, access to the test set-up is through a smaller door on its opposite side.

Ambient temperature inside the box can be raised to 600 F in 5 minutes or 1200 F in 20 minutes,

wall

under no-load conditions. Restricting the air exhaust vent keeps the pressure slightly above atmospheric. As a safety device, an oxygen analyzer monitors the chamber.

Both doors are sealed with a Neoprene sponge gasket mounted on a water cooled jacket. The water temperature in the door seal is kept above the dew point of the chamber atmosphere to prevent condensation.

Interlocks keep doors locked while the system is operating under hazardous conditions. Exhaust fans prevent combustible gas build-up. In case of hydraulic line failure or fire, the room is flooded with CO_2 gas and the complete hydraulic system, chamber and exhaust fans shut down automatically.

HYDRAULIC SYSTEM

Capable of supplying 20 gpm of fluid at 5000 psi from 80 F to 800 F, this system consists of two major sections: primary heating and high pressure test fluid.

The primary system supplies controlled temperature fluid to the high pressure system. A gear pump circulates 65 gpm past 24 immersion heaters of 10 watts per square inch density and a total capacity of 60 kw. This system requires 1½ hours to stabilize at 500 F. After stabilization, the 7 to 10 gallons in the test system may be raised to 400 F in 20 minutes. The primary system, through a heat exchanger heats 3 separate 25-gpm systems, each differing in fluid and temperature.

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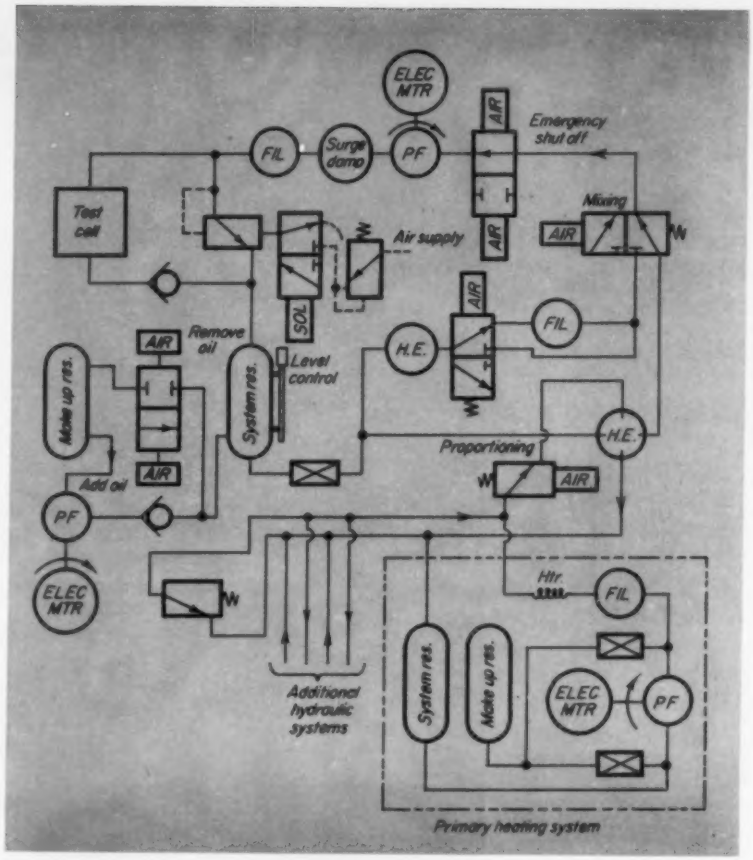
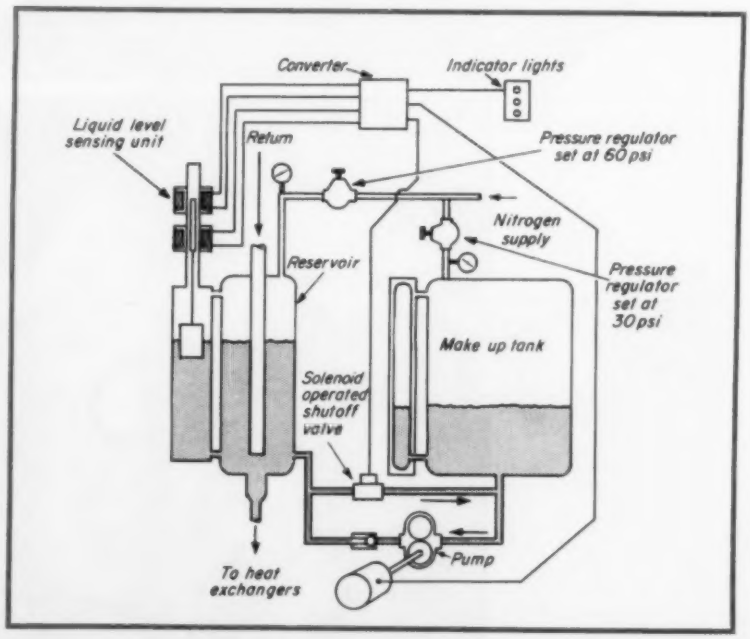
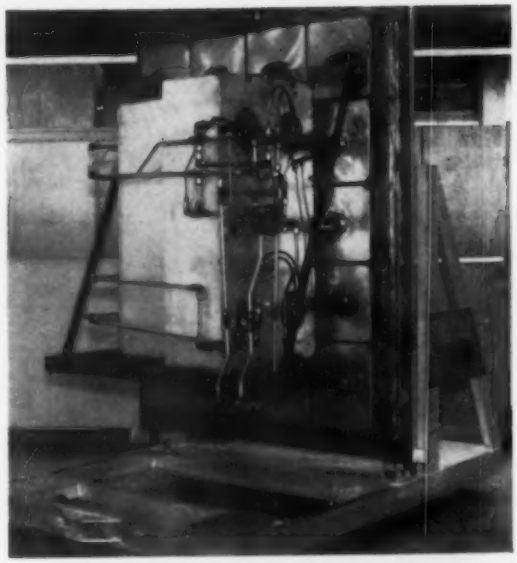


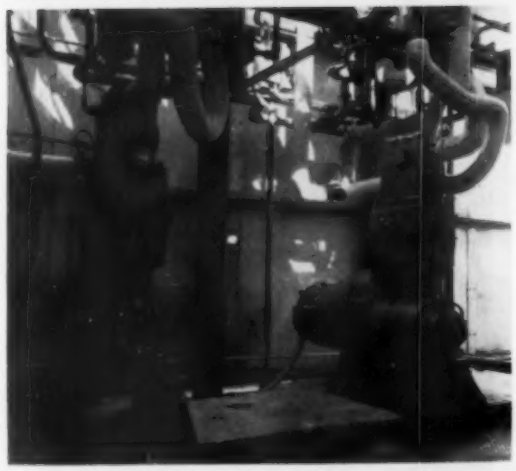
PRIMARY HEATING SYSTEM supplies high temperature fluid to the test system. Heat exchangers maintain control temperatures to 550° F.



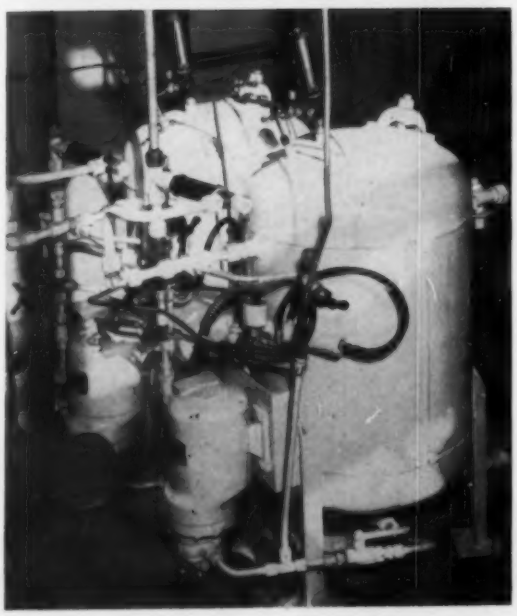
LEVEL CONTROL of reservoir and make-up tank system. Shut-off valve functions at the command of the liquid level sensing element.



INTERIOR SIDE of removable wall, showing the 2-inch ports spaced on 12-inch centers. Hot test specimens are mounted on large bracket.



PRESSURE SOURCES for the test system consist of these industrial 3-piston, reciprocating plunger pumps, installed outdoors adjacent to the test building.



MAKE - UP RESERVOIRS for the test systems.

HOT FLUID TEST

The test system is pressurized by an industrial type, 3-piston, reciprocating plunger pump which can deliver 20 gpm at 5000 psi and 550 F. The pulsations are dampened by a special damper with no moving parts, which can operate indefinitely at 5000 psi at temperatures to 1000 F.

A make-up reservoir allows the system to be drained for maintenance. This reservoir may also add or remove fluid during tests.

When the control temperature is reached, the heat generated by the work load often exceeds the heat loss of the system. A second heat exchanger is used to remove the excess heat.

A 5-gallon system reservoir is kept half full by a level control. When the level sensing element detects high level, a shutoff valve opens allowing fluid to flow from the system to the make-up tank. At low level, the flow is reversed. Fluid expansion during warm-up is also compensated for by the level control. The system reservoir is pressurized by nitrogen to 60 psi. (30 psi in the make-up tank).

This system has been a very successful leak indicator, because a minor change in fluid volume is immediately shown by lights on the control panel. In many cases, the level indicator gives the first warning of a hydraulic leak.

PNEUMATIC SYSTEM

To cope with high hydraulic pressures and rapid response rates, pneumatic diaphragm - operated valves are used in the system. For example, one is used as a relief valve between the reciprocating pump and the test cell. When oil pressure becomes excessive, a solenoid-operated 3-way valve is energized by a pressure switch. The diaphragm valve is then opened by pressure-regulated air, permitting oil to flow back to the reservoir until system oil pressure is stabilized. Constant line pressure is maintained regardless of unforseen fluctuations in the test pressures. □□□

Over 10,000 valves in operation

APCO SERVO LOADERS

Wherever high-pressure pneumatics are used, the APCO series of high- and ultra-high pressure regulators provides the ultimate versatility for instrumentation and service systems applications. APCO Servo Loaders accept the highest inlet pressures—provide the widest range of *precise* outlet pressures... are easily adjusted through a low-torque planetary gear handle or a 28 V DC actuator. Available with either ¼-inch tube or ¼-inch NPT threaded ports—valve and filter may be removed for inspection, cleaning, or replacement without disconnecting the regulator from its system!... Write today for technical data.

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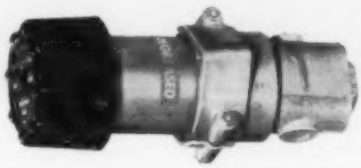
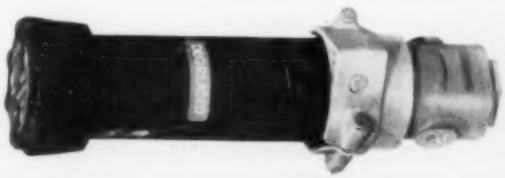


110400
- Extreme accuracy in control
- Inlet pressure – 6000 psi
- Regulated outlet pressure in specified ranges

113300
- All stainless steel construction in flow area – cleaned for LOX
- Inlet pressure 6000 psi
- Regulated outlet pressure – as specified



110700
- Maximum handle torque 35 lb-inch
- Regulated inlet pressure 6000 psi
- Regulated outlet pressure – 150 to 5000 psi

117300
- Maximum handle torque 50 lb-inch
- Inlet pressure 10,000 psi
- Regulated outlet pressure – 100 to 8000 psi

APCO ACCESSORY PRODUCTS CO. / DIVISION OF TEXTRON INC.

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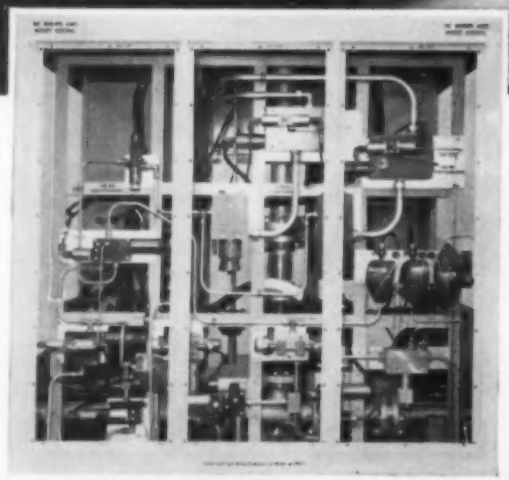
WILL IT WORK UP HERE?



Vinson valves are used in the dynamic checkout unit built by Consolidated Systems Corporation for use in the Atlas missile program.

Behavior of helium and nitrogen valves can be predicted if you simulate conditions and pre-test on the ground. Pressure regulators, relief valves, and flow controls must be better than the systems they are checking. It takes knowledge gleaned from experience to design ground support units that guarantee expected behavior of a missile *up here.*

Vinson designed valves and regulators for both the dynamic and static checkout systems for the Atlas. Whether your control problem is simple or complex, consult Vinson engineers.

Differential relief, solenoid and priority *valves.*
Flow and pressure *regulators.*
Reservoirs and *accumulators.*

EXPECT MORE FROM **VINSON** SYSTEMS

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AVIATION NEWS

from the fluid power field

Frank Mladinich of **Grumman Aircraft Engineering Corp.** has joined the Aviation Editorial Advisory Board of APPLIED HYDRAULICS & PNEUMATICS. He joined Grumman 18 years ago.

Mladinich

Frank's hydraulic experience dates from 1942 when he became a designer in the experimental department. In the past 17 years he has been a group leader of hydraulic systems and is now chief of the engineering division's hydraulics and pneumatics group. Mladinich is a member of the SAE A-6 Committee and its High Temperature Sub-Committee.

Gerald Shane was named sales engineer by the **Gladden Products Corporation.** He has an extensive background in the design and development of hydraulic and pneumatic components, and will serve the aircraft and missiles industries.

The Flodar Corporation and **Thompson Ramo-Wooldridge Inc.,** both of Cleveland, Ohio, have arranged to manufacture and market an improved line of aircraft tube fittings. The fittings, called "Thompson-Flodar" is an aircraft version of Flodar's self-flare design to be manufactured by Thompson Ramo-Wooldridge for the advanced aircraft and missile field.

Arthur C. Cocagne, for the last nine years in executive posts with William R. Whittaker Co., Ltd., has been made director of sales of **Meletron Corporation.** He has accrued many years of engineering service for major aircraft and engine manufacturers.

W. K. Venatta is now manager of the manufacturing department of the **Oronite Chemical Company.** With the company since 1948, he was recently manager of Oronite's Oak Point, La. plant.

Moog Servocontrols, Inc., announced that **W. J. Thayer** is assistant chief engineer. In 1957,

Thayer

he joined the company as chief development engineer.

R. C. Colburn has joined the sales staff of the **Vinson Engineering and Sales Co.,** Van Nuys, Calif. **E. R. Blades** of Phoenix, will represent the company in Arizona and New Mexico.

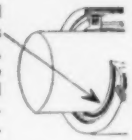
Circle **2** on Time-Saver Card

Fall . . . the original

SPRING-LOADED

Wiper **Ring**

This patented closed joint ring provides squeeze-grip action, assuring complete contact on the rod at all times. Maintains uniform, continuous pressure on wiper edge. Rods are always clean in any temperatures.



Fall "CJ" Wiper Rings operate most effectively under extreme conditions of dust, glaze, oil, grit, powder, gases, sand, ice, etc. Available in diameters ½" through 13". For any commercial use. Used by military and aviation industry since 1944.

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MC 2004-20 COMPRESSOR

as our many other products, can be adapted to your particular need while retaining the *Reliability* built in by us through design, processing, production, final quality control, and delivery.

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G-T RINGS

For ROD SEALS . . .

For PISTON SEALS . . .

PALMETTO G-T RINGS are resilient packing seals molded from a variety of natural or synthetic rubber compounds into T cross-sections, with two split non-extrusion backup rings on each side. They are used in hydraulic or pneumatic operations as rod or piston seals, in single or double acting systems; for all applications where there is reciprocating motion, with either constant or impulsed pressure; and as static seals, under constant or impulsed pressure.

PALMETTO G-T RINGS effectively seal, without extrusion, at temperatures from minus 70F up to 600F, and at pressures as high as 10,000 p.s.i. They will not wedge into clearances, pinch-off under motion or pressure, or twist in place. Absolutely resistant to destructive deformation, they permit the use (within reasonable limits) of greater clearances between the surfaces being sealed.

PALMETTO G-T RINGS are manufactured to fit standard size bores and rods, and are available in a wide selection of compounds compatible with all types of fluids in a broad temperature range. Special G-T Ring sizes can be made, on order, to meet any design requirement. Several kinds of non-extrusion backup ring materials are also available.

G-T Ring compound 160A complies with Military Specification:
MIL-R-003065 Grade SB 715 BE_3Z.

FREE ILLUSTRATED BOOKLET: Just published, this useful literature is complete with product descriptions, technical data, specifications, and suggested uses of PALMETTO G-T RINGS for the design engineer . . . Write for your copy of Booklet GTR-759 today.

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PALMETTO KUP	SHEET-PACKINGS
PALMETTO FLANGE	NON-LUBRICATED PACKINGS

Whatever your sealing problem, Palmetto engineers will give you personalized design service and work with you to engineer the specific type of packing your process or product requires.

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North Wales, PA.

Circle **52** on Time-Saver Card

AVIATION COMPONENT DATA

Selector Valve . . . is 3-way

This 3-way, 3-position, manually-operated rotary selector valve

uses a spool fitted into a forged stainless body, also serving as a sleeve. This cuts down the number of packings usually required, increasing its reliability.—*Hydra-Power Corp., New Rochelle, N.Y.*

Circle **500** on Time-Saver Card

Inline Relief Valve . . . is light weight

Allowing free flow in the reverse direction, this valve has a rated flow pressure of 3850 psi at

27 gpm. Operating temperature range is −65 F to +275 F. Pressure drop is 150 psi at 15 gpm reverse flow. Weight is 0.67 pounds.—*Arkwin Industries, Westbury, N.Y.*

Circle **501** on Time-Saver Card

Solenoid Valve . . . has 15 m.s. response

The V-27200 series for high pressure pneumatics and hydraulics operates in the 500 F temperature range. Made to 4500-psi requirements, response rate is 15 milliseconds.—*Valcor Engineering Corp., Kenilworth, New Jersey.*

Circle **502** on Time-Saver Card

Metal O-rings . . . are electro-plated

To improve sealing under marginal conditions, a .001 to .0015-in. soft metal coating is added to the standard metal O-ring. Silver is most common, but cadmium, nickel, copper and gold have been used for specific applications.—*Advanced Products Co., North Haven, Conn.*

Circle **503** on Time-Saver Card

Air Compressor . . . for high temperatures

A 9-cylinder, 3-stage, radial compressor, efficient even at high

temperatures. Uses a 12-inch fan with a 1000 cfm flow capacity. Weighing 28.25 pounds, the motor-driven compressor can be used for ground support equipment.—*Cornelius Co., Minneapolis.*

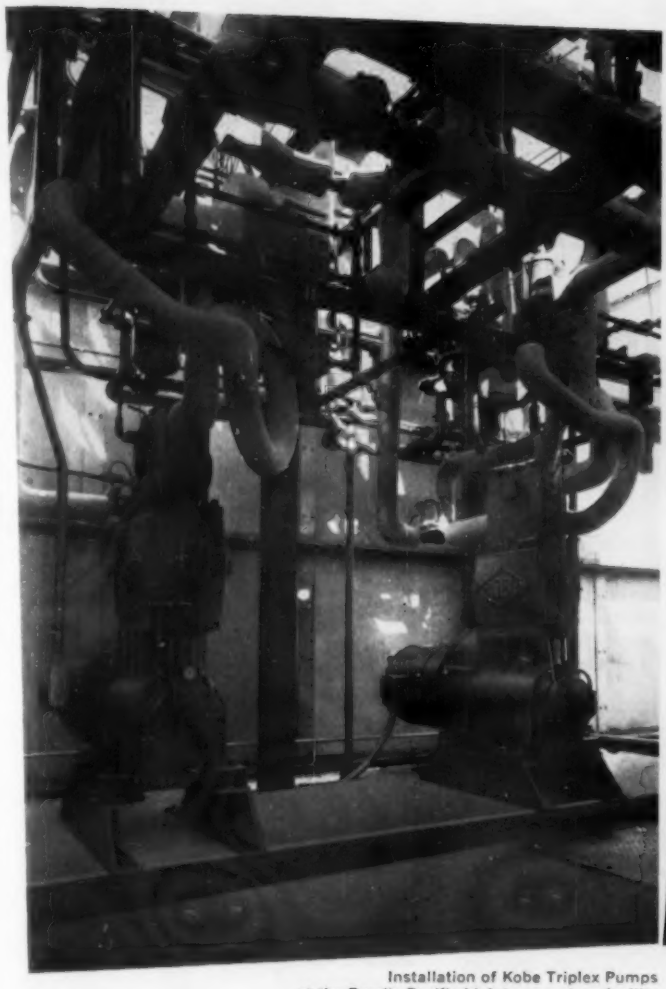
Circle **504** on Time-Saver Card

New Catalog . . . for in-line filters

A six-page catalog, No. BFD-64 describes T-type in-line filters, elements, dual bowl filters, and differential pressure indicator filter assemblies.—*Bendix Filter Division, Madison Heights, Mich.*

Circle **505** on Time-Saver Card

Continued on page 108



Installation of Kobe Triplex Pumps
at the Bendix-Pacific high temperature facility

THE HOT PUMP ANSWER *for high temperature hydraulic testing*

The **KOBE TRIPLEX** *Pump*

Over the past two years the Kobe Triplex pump has been proved capable of pumping hydraulic fluids at temperatures ranging from –65°F. to 550°F., at pressures up to 5,000 psi. Two different companies have each logged more than 1,000 hours on a Kobe Triplex at temperatures in excess of 400°F. Neither of those two installations nor any other in high temperature service have experienced any repair or replacement problem.

The Kobe Triplex is characterized by having metallic gaskets for all static seals in the fluid end, and by a metal-to-metal lapped fit on the plungers and liners. There is no requirement for cooling any part of the pump in high temperature service.

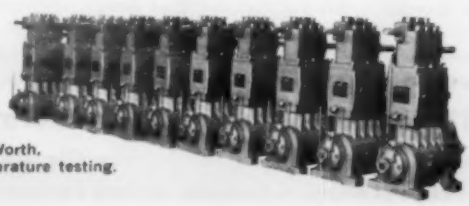
When used in a high temperature facility, the Kobe Triplex eliminates the requirement for a high pressure heat exchanger. The pump permits the design of a test stand with a minimum of fluid in the system and thereby minimizes the maintenance cost of periodically replacing expensive hydraulic fluids. Technical data on request.

Also pumps for

HYDRAULIC COMPACTION
STRESS ANALYSIS
TESTING PRESSURE VESSELS

In addition to the standard 5,000 psi units, Kobe Triplexes are available with pressure ratings of 10,000 psi and 20,000 psi, and a 50,000 psi version is now being developed. These are suitable for use with oil or water with soluble oil.

We will, of course, welcome an opportunity of quoting on your requirements. Please call or write –



Recent shipment
of 10 Kobe Pumps
for Convair, Ft. Worth,
for high temperature testing.

KOBE INC.

AIRCRAFT SALES DIVISION

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and no oil leakage

specify NARDA Piston Accumulators

FEATURING:

- Self-balancing piston
- Triple "O" ring seal—all three active
- Auto-relieving piston
- End caps provide dashpot action and use same seals as piston, thus requiring only one seal size for spare parts.

FOR:

- Auxiliary power
- Surge dampener
- Emergency power
- Leakage compensator
- Pressure transfer barrier

THREE MOST POPULAR SIZES:

One quart, one-half gallon and one gallon, 13", 18⅛" and 28½" long, respectively. All 4¼" diameter. (Larger sizes: 2½, 5, 10 gallons; all 8⅝" diameter.)

Standard temperature range:—40° to +220° F. Seals also available for fuels and special fluids as well as for temperatures from —65° to 400° F.

For more information about these new Narda Accumulators, as well as other models now in development, write to us at Dept. AHP-2.

Some distributorships in Western and Southern states still open.

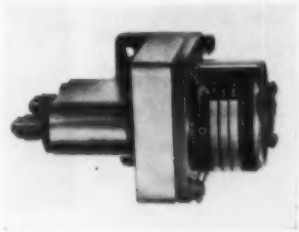
the narda hydraulics corporation
122 HERRICKS ROAD, MINEOLA, N. Y.
Subsidiary of The Narda Microwave Corp.

Circle **125** on Time-Saver Card

AVIATION COMPONENT DATA

Back Pressure Valves . . . in stainless steel

Pressure control is held to within 0.1 psi through a flow range of



500 psi at inlet and 80 psi at outlet, and an operating range of —70 to +175 F. Weight is 0.75 pounds.—*Applied Dynamics Corp., Natick, Mass.*

Circle **506** on Time-Saver Card

Pressure Switches . . . in new brochure

General purpose switches, including pneumatic and hydraulic types, high vibration models and differential pressure units are listed and described. Also special units, such as altitude switches, high temperature (650 F) models and pressure ratio switches are discussed.—*Consolidated Controls Corp., Bethel, Conn.*

Circle **507** on Time-Saver Card

Pressure Regulator . . . with relief valve

Regulator has inlet pressure of 40 to 60 psi and outlet pressure of 15 to 30 psi, a burst pressure of

10:1. Flow range is 0.5 to 20 gpm or a 40:1 ratio. Temperature range is 60-200 F. Maximum fluid viscosity is 30 centistokes.—*Cox Instruments Div., Detroit.*

Circle **508** on Time-Saver Card

2nd printing now available

AIRCRAFT HYDRAULIC DESIGN

• **The first book** dealing with hydraulic component and system design for high-speed piloted aircraft and missiles, has been written by a leading aircraft engineer. Developed from practical and theoretical material, the book develops many basic equations including those relating pressure gradient, flow-path dimensions, flow rate, velocity, fluid density, and viscosity.

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A new light weight (3.75lbs) regulator that **guarantees** a constant outlet pressure for any setting from 0 to 5000 PSI. Specially designed for precise laboratory instrumentation, qualification testing, or field service, these regulators operate with "bottle", tank or compressor feed. They have built-in automatic relief for system protection.

AMAZING SIMPLIFIED DESIGN REQUIRES ONLY ONE ADJUSTMENT FOR BOTH RELIEF VALVE AND PRESSURE OUTLET SETTING.

- Extremely accurate sensing
- Low in cost
- Qualified
- Immediate delivery
- Inlet pressures to 6500 PSI
- From −65° to +275°F
- Hi-flow—helium, air, nitrogen
- Available for manual or electrical remote control

Write for more information. (Catalog #8225).
Note: Dealer/distributor inquiries invited.

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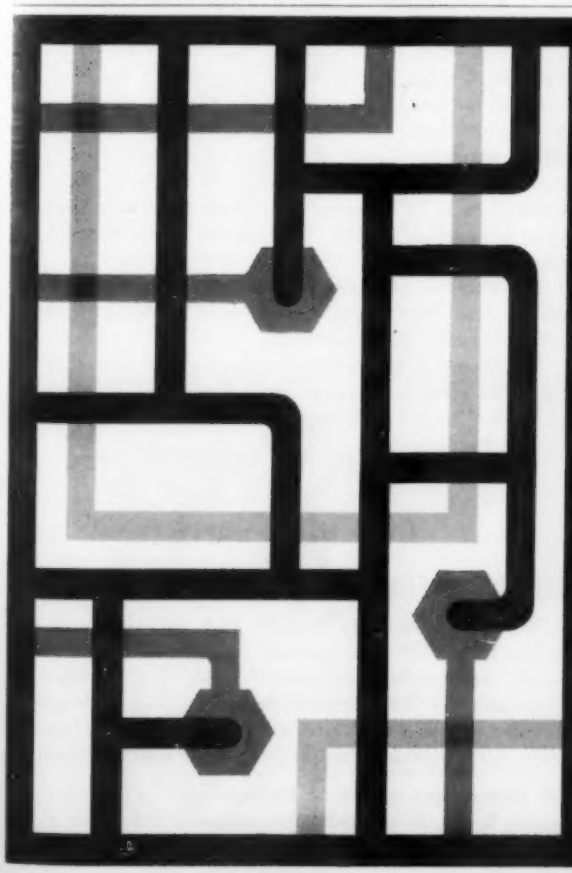

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missile/aircraft valve design engineers

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GAST
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Six sizes . . . all variable speed, explosion-proof

GAST rotary vane AIR MOTORS

Need compact, low cost power? For plant use and original equipment applications, Gast rotary-vane Air Motors offer these distinct advantages:

1. Explosion-proof power. No danger!
2. Low initial cost per rated h.p.
3. Variable speed with valve control.
4. Can't burn out from overloads.
5. Vanes take up their own wear.
6. Reversible rotation (opt.) 5 sizes.
7. Very compact — light in weight.
8. Top-quality ball-bearing design.

TYPICAL PERFORMANCE		
Model No.	H.P. at 90 PSI 2000 RPM	Weight lbs.
1AM	0.13	1½
2AM	0.57	5½
4AM	1.1	8
6AM	2.0	17
8AM	4.0	25
16AM	7.0	65

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GAST ROTARY
• AIR MOTORS TO 7 H.P.
• COMPRESSORS TO 30 P.S.I.
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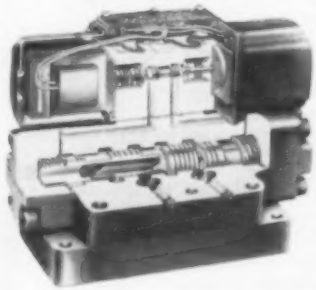
"Air may be your answer!"

Designer's Fact File from DENISON

HYDRAULIC 4-WAY VALVES



For shockless, hydraulic control on any directional requirement. Pilot-operated, solenoid controlled. Built-in check valve provides pilot pressure without addition of another valve to the system. Has drawn steel solenoid covers secured to body with internal retaining cords. For pressures to 5,000 psi.

Write For Details In Bulletin 240-B.

DENISON ENGINEERING DIVISION
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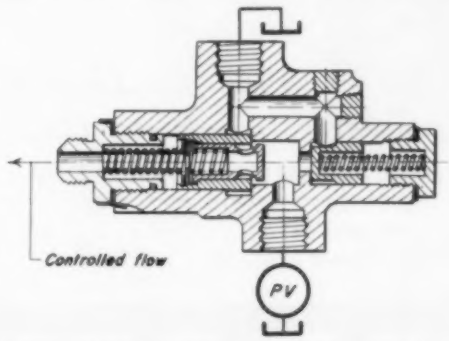
Circle **36** on Time-Saver Card

FLUID POWER PATENTS

BYPASS FLOW REGULATOR

Regulator is designed for use on mobile equipment. When placed in the pump discharge line it will supply a constant volume of fluid through one port, regardless of engine speed. Excess pump volume is returned to the reservoir through a bypass port.

Pump discharge enters the pressure port on the valve and passes through holes in the hollow sleeve to the left, and out the controlled flow port. When pump flow exceeds the capacity setting of the valve, the resulting pressure drop across the sleeve moves it to



the left. As the sleeve moves deeper into the bore, more of the holes are covered and the flow decreases. As pressure within the regulator increases further, the larger diameter sleeve also moves left and allows a portion of the fluid to return to the reservoir. Movement of these two sleeves against their springs maintains a constant volume through the controlled flow port.

The valve is also pressure compensated. Increased pressure in the controlled flow port works with the springs to keep flow constant.

If pressure in the system increases above a set limit, the relief valve at the right opens and discharges part of the flow back to the reservoir.

U. S. Patent 2,858,842, Smil Reis, Milan, Italy.

DECOMPRESSION VALVE

The valve gradually releases high pressure from a press ram when the control valve shifts after the work stroke. Bleeding is adjustable and increases gradually as the pressure decreases. Ram pressure tending to close the valve is opposed by spring pressure. An adjustable stop prevents closing it completely.

• **Operation** — A hole through the center of the spool keeps it in hydraulic balance. Oil from the

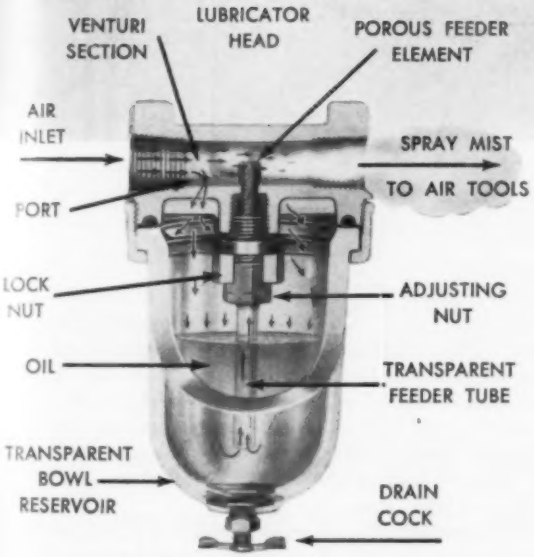
Continued on page 112

Circle **14** ➡

Arrow AIRLINE SPRAY MIST LUBRICATORS

Supply a fine Spray Mist Lubricant by the most efficient and effective two-stage method!

By PRE-DIVIDING or breaking up the oil in the first stage before completely atomizing the Lubricant in the second stage. The Spray Mist is then carried along throughout the entire pattern of the air stream to lubricate the working parts of air-powered tools, cylinders, valves and other pneumatic devices.



Illustrates the operation of the ARROW "patented" two-stage, tamper- proof Lubricator.

Compressed air from the drop line enters the Lubricator to Venturi section of the Lubricator Head where the porous feeder element protrudes into the Air Stream.

Small ports in front of the porous feeder permits air pressure transfer on the oil surface in the bowl reservoir. The pressure differential created by the Venturi forces the oil to rise in the transparent feeder tube, into and through the porous feeder element which PRE-DIVIDES the Lubricant in this first stage, into minute particles of oil.

The Lubricant now finely divided and saturating the porous feeder element, is now easily and most efficiently atomized from the feeder element, at this second stage, by the action of the Venturi on the compressed air passing through the Lubricator Head.

The two-stage method incorporated in the ARROW LUBRICATOR insures a fine spray mist for wider ranges of AIR FLOWS at lower pressure drops.

Simplicity of design with only one tamper-proof adjustment provides for most efficient, low-cost operation.

PROTECT YOUR PNEUMATIC EQUIPMENT

Complete Conditioning and Control of Compressed Air Prolongs Service Life, Reduces Maintenance and Repair of Air-Powered Tools, Cylinders, Valves and Other Pneumatic Equipment.

the most Efficient and Complete AUTOPNEUMATIC CONTROL By Arrow

A choice of fine or coarse grade porous Bronze Feeder Wick as required for lubricant or application. A choice of Hand Filling Type Lubricator or a Pressure Filling Type with Button Head Fitting or the ARROW . . . New Fully Automatic Filling Type which with the Automatic Drain Trap makes Autopneumatic Control completely automatic, eliminating all hand or manual servicing.

Many Types and Models of Single Units and Units in Combination Assemblies to Meet Specific Requirements.

PIPE LINE SIZES—
¼"—⅜"—½"—¾" and 1" N.P.T.

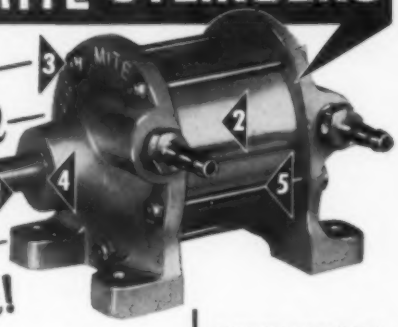
Catalog and Engineering Data Sent on Request.

ARROW TOOLS, INC. 1934 S. KOSTNER AVE. CHICAGO 23, ILL.

Circle **7** on Time-Saver Card

AIR-MITE AIR CYLINDERS

Compact—
Powerful—
Rugged—
Low Cost!

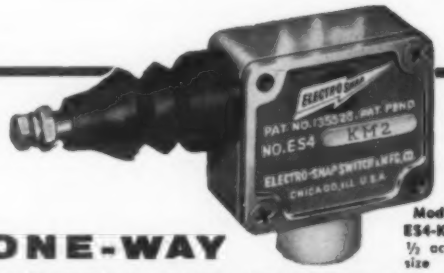


AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:

1 Ground and polished steel ram
2 Brass, true-bore cylinders
3 High strength aluminum alloy cylinder heads
4 Bronze oilless ram bushing
5 Five steel tie rods

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.



Model ES4-KM2 ½ actual size

ONE-WAY IMPULSE SWITCH
simplifies sequencing circuits

★ Eliminates Interlocking Switches and Complicated Actuating Dogs
★ Exclusive one-way actuator sends electrical pulse when depressed, then opens circuit. No pulse on actuator return.
★ Gives More Dependable Operation — replaces complicated controls
★ Lowers Cost of Control Circuits—fewer switches required
★ Faster Automatic Operation — closer sequencing possible

10 amps, 125v AC
Four models available with pulsing strokes from 1/16" to 3/8".
Described in Data Sheet ESF-8

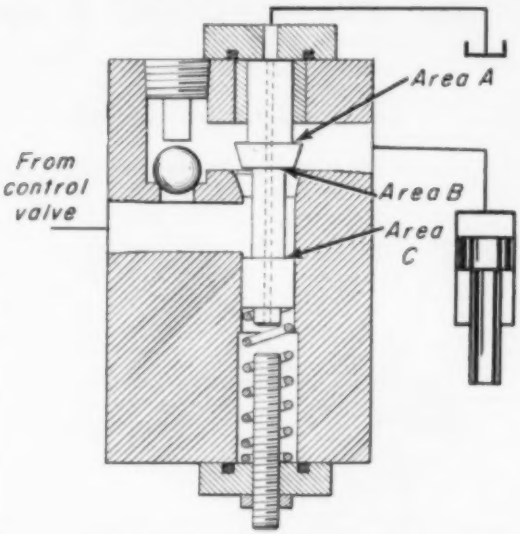
$10.50
plus 25c shipping
Write for Quantity Discounts

ELECTRO SNAP
ELECTROSNAP CORPORATION
Switch Division
4224 W. Lake St., Chicago 24, Ill.

Circle **42** on Time-Saver Card

control valve flows through the ball check valve to extend the press ram. When the ram meets resistance and pressure builds up, the spool is forced down until it hits the adjustable screw stop. This stop allows only a small opening at the valve seat.

When the control valve shifts to drain the press ram, oil is forced between the top spool land and



the seat. The check valve prevents any bypass flow. The spring force and areas *A*, *B*, & *C* control the rate of decompression. The combined areas *A* and *C* exceed area *B*. Therefore, ram pressure tends to close the valve against spring force. As ram pressure decreases, the spring gradually opens the valve to allow more oil through. The ram smoothly accelerates until the valve is wide open.

By changing areas and spring force, any combination of decompression and acceleration can be gotten.

U. S. Patent No. 2,870,782 by Robert J. Lindsey, assigned to American Steel Foundries, Chicago, Ill.

Other Patents Issued

HYDRAULIC ACTUATOR

No. 2,882,869 by John Albert Krapf, Cleveland Heights, Ohio.

HYDRAULIC RELIEF VALVE

No. 2,882,922 by Arnold Schindel, assigned to Bendix Aviation Corp., Teterboro, N. J.

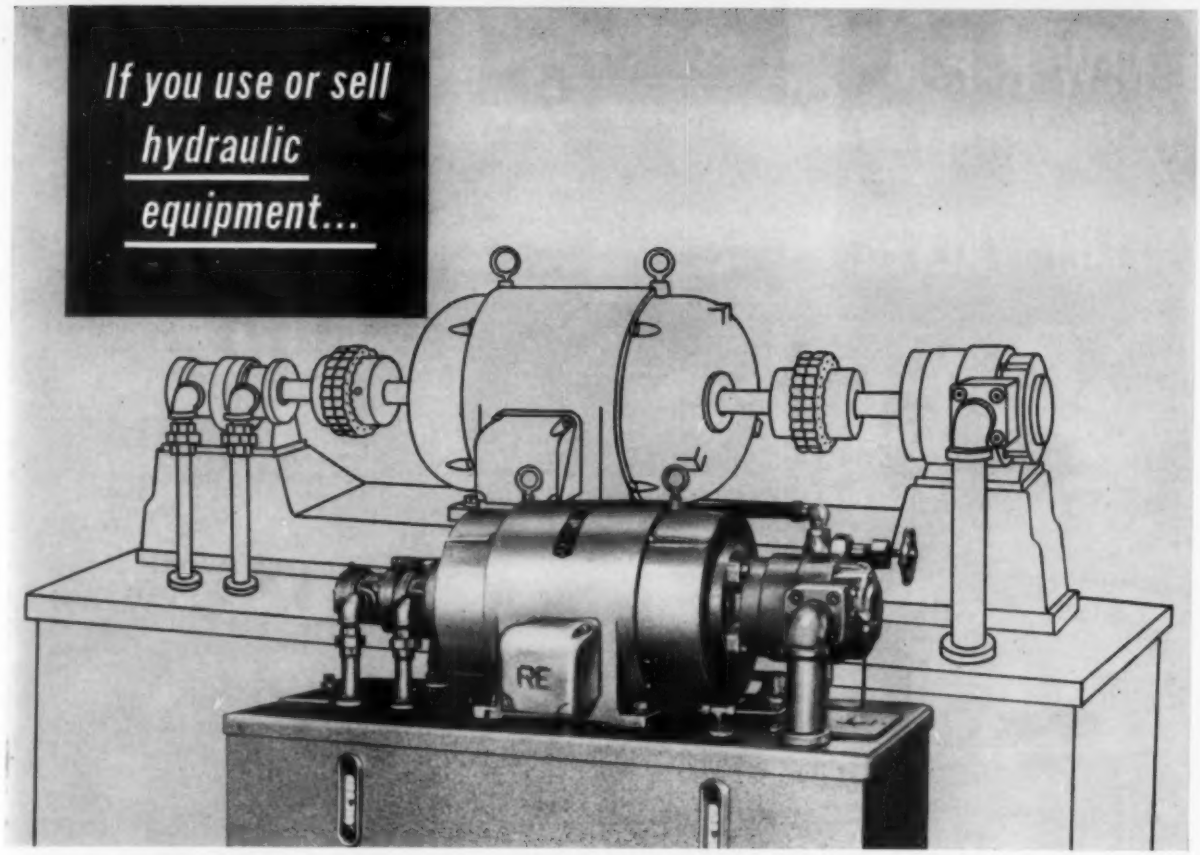
FLOW CONTROL VALVE

No. 2,882,926 by John F. Hedge and Cecil E. Adams, assigned to American Brake Shoe Co., New York.

PILOT-OPERATED 3-WAY VALVE

No. 2,882,829 by Allan W. Churchill and Albery V. H. Canfield, assigned to Automatic Switch Co., Orange, N. J.

If you use or sell hydraulic equipment...



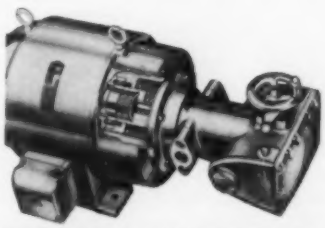
...specify REULAND spline-coupled pump mount motors

...CUT SPACE NEEDS ALMOST 50%... AVAILABLE *NOW* IN ½ H.P. THROUGH 50 H.P.!

Pump and motor become *one* with the new Reuland spline-coupled hydraulic pump hook-up. The pump shaft is connected directly to the motor's shaft *inside the motor.* Flexible couplings are eliminated... pump mount platforms are eliminated... and the tank length can be reduced because almost 50% less mounting area is required. Compact appearance is beautiful.

SPEEDY INSTALLATION

Pump-to-motor hook-up is merely a matter of seconds. All you do is slip the spline coupling onto the pump shaft...and attach the pump to the endbell. This spline coupling is supplied with the motor and is precision mated for each make of pump. There's no time wasted tinkering around... takes only a fraction of the ordinary time.



PRECISION ALIGNMENT

Alignment is perfect *automatically* whether the installation is made out in the field or on the production line. This permits even unskilled workmen to handle this simple task without error. Also, by hooking the pump up at the point of bearing support, within the motor, vibration is reduced to a new minimum. Operation is smooth, quiet.

COSTS LESS...SAVES INSTALLATION LABOR... FITS ALL PUMPS...FILLS ALL POWER NEEDS—

½-50 H.P. The Reuland spline-coupled unit is priced lower than a conventional set-up ...saves you extra money by reducing installation costs. What's more, we can supply it to fit any make of pump you may be using...and to your *exact* power needs, from ½ h.p. through 50 h.p. So sure are we that it will be of help to you, we are offering to engineer a demonstration unit to your equipment, without the slightest obligation. These units are our best salesmen.

Our New General Catalog Will Come In Handy—Sent Free on Request.

MODERN POWER FOR MODERN-DAY PRODUCTS

REULAND MOTORS

REULAND ELECTRIC COMPANY
WESTERN DIVISION: Alhambra, California
EASTERN DIVISION: Howell, Michigan
DISTRIBUTORS IN ALL PRINCIPAL CITIES

*Trademark Registered

NEW H-P-M 3/8" • 3/4" • 1 1/4" RELIEF VALVES

3000 psi, 0 to 65gpm

Low Override • Controlled Venting • High Cracking Pressures

► H-P-M's new gasket mounted, pilot-controlled relief valves are completely interchangeable with industry standards. Close control of cracking and override pressures assure long life and trouble-free operation. Controlled venting pressures assure dependable pressure control for your most exacting requirements.

H-P-M's relief valves are available from stock for immediate delivery. Write today for complete information on these compact pressure controls.

The price is important.

THE HYDRAULIC PRESS MFG. COMPANY
A Division of Koehring Company
Mount Gilead, Ohio, U.S.A.

HPM

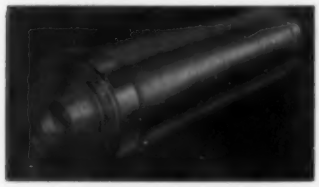
Circle **60** on Time-Saver Card

NEW PRODUCTS

Continued from page 54

PISTON ACCUMULATORS
. . . assure simple maintenance

Features: Simple, unique design assures simple maintenance. Meet



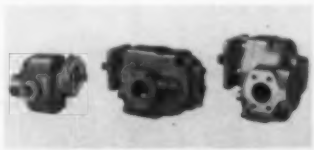
ASME, ICC, PUC specifications. Units designed so it is impossible to disassemble while precharged. Incorporate free floating piston, using same O-ring seals as end caps, reducing inventory.

Specifications: Operating pressure, 3000 psi; proof pressure, 6000 psi.

Beach Mfg., Inc.
Compton, Calif.
Circle **312** on Time-Saver Card

HYDRAULIC PUMPS
. . . with capacities to 150 gpm

Features: Designed for off-highway, construction, industrial and aviation equipment plus mobile field units. Lightweight, aluminum, available in either rotation direction. Absorb shock, are quiet run-



ning. May be dismantled in field and rebuilt without efficiency loss. Seal replacement simple field operation.

Specifications: Capacities 4-150 gpm, pressures to 2000 psi, speeds to 3000 rpm.

Hydraulic Products Division.
Clark Equipment Co.
Benton Harbor, Mich.
Circle **313** on Time-Saver Card

LIMIT SWITCH
. . . has little friction

Designation: Loxswitch Model M
Features: Designed with all major friction points of nylon or oil impregnated bearings. Nylon-to-nylon heavy-duty latch mechanism tested for 45 million cycles. Can fit many existing layouts and available in plug-in style for replacement or direct wiring. Has two completely isolated circuits—normally open and normally closed—with positive double break and full contact pressure maintained constantly. Has 600 v. industrial rating.

Specifications: Measures 1 7/16" wide by 3 7/8" long. Available in three bases, including flush mounting design. Five lever styles stocked in various lengths, two with adjustable features. Contact gaps 3/8" wide, eliminating possibility of contact welding.

R. B. Denison Mfg. Co.
Cleveland, Ohio
Circle **314** on Time-Saver Card

ACTUATOR SWITCHES
. . . have side plungers

Features: Slide roller plunger models for actuation by fast cams

and slides; side plunger models for slow cams, slides. Actuator heads may be mounted in 4 positions, 90° apart. Oiltight. Switches "lie down" in close quarters. Easily removed and replaced.

Specifications: Maximum operating force, 6 lb., differential travel, .040". Minimum release force 2 lb., overtravel, .250" and .219.

Micro Switch
Division of Minneapolis-Honeywell Regulator Co.
Freeport, Ill.
Circle **315** on Time-Saver Card

AIR HOSE
. . . ignores weather

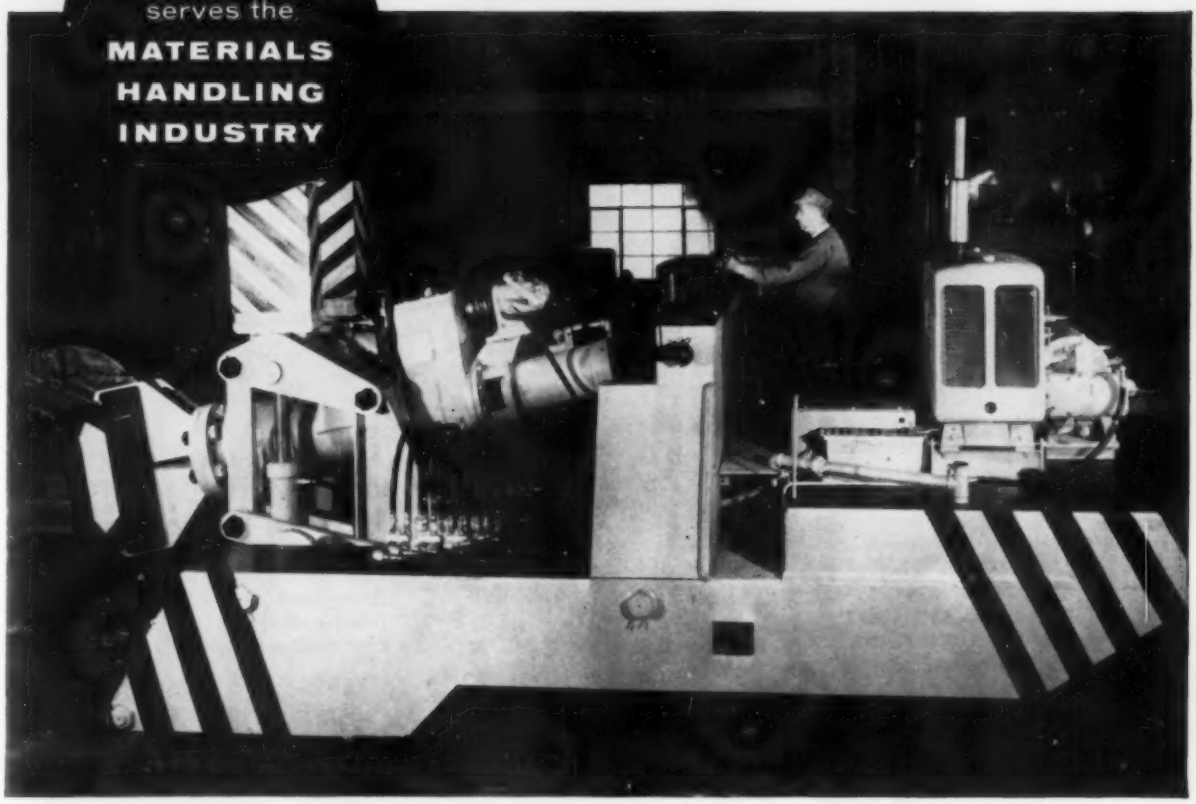
Designation: Universal

Features: Will not "balloon" in hot weather, or stiffen in cold weather. Ideal for use with portable air-operated tools since it reduces operator fatigue and gives more mobility. Possesses nylon's

Continued on page 116

How **DENISON** serves the **MATERIALS HANDLING INDUSTRY**

HYDRAULIC-POWERED *manipulator built by Salem Brosius, Inc., Carnegie, Pennsylvania, uses Denison 5,000 psi axial piston pumps and motors and 2,000 psi vane-type motors to assure peak hydraulic-controlled efficiency.*



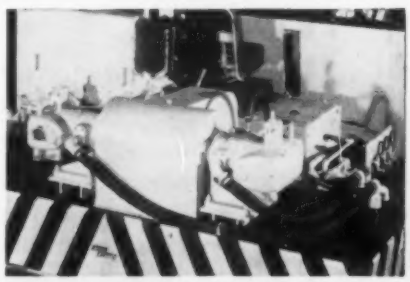
DENISON hydraulic-powered, this **SALEM BROSIUS**

Manipulator handles forgings 15% to 20% faster

Substantial savings in time and cost, through 15% to 20% faster handling of forgings, are accomplished with Salem Brosius' manipulator. Powered and controlled hydraulically with Denison pumps and motors, it has exceptional flexibility to perform the functions of charging machines, cranes, conveyor tables and roll chains, as well as the work of a manipulator.

Through the Denison hydraulic control, precise positioning of work in dies reduces rejects and off-quality work. Faster handling cuts reheats and fuel costs.

Whatever product you manufacture, it is likely that benefits through speed, added power and dependability can be incorporated at nominal cost. Ask your Denison representative to look over your requirements.



HYDRAULIC SYSTEM *for powering Salem Brosius forging manipulator. Powered by independent gasoline engine for in-plant mobility.*

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
1166 Dublin Road • Columbus 16, Ohio
Denison Stocking Branch Offices: CHICAGO • DETROIT
LOS ANGELES • HOUSTON • ATLANTA • NEWARK • CLEVELAND

Denison and Denison HydrOILics are registered trademarks of Denison Eng. Div., ABSCO

DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

Circle **61** on Time-Saver Card

HUSCO HYDRAULIC CYLINDERS

Basic Designs Adapted to Cost-Saving Custom-Engineering

You'll solve your special Hydraulic Cylinder needs faster, at lower cost, by a quick call to HUSCO—and a custom-engineered modification of one of many HUSCO Basic Cylinder Designs . . .

Telescoping, Single-Acting, Double-Acting Differential Types in many sizes, offer features that assure improved performance, longer service, lower initial and operating cost, on your equipment. Write for details—or the answer to one of your problems.

Check HUSCO *first* for modern hydraulic units engineered to your specific needs. Write or phone . . .

HUSCO
HYDRAULIC UNIT SPECIALTIES CO.
Pumps • Valves • Cylinders
P. O. Box 257-A • Airport Road • Waukesha, Wisc.

MUNRAY AIR HOSE

- Non-Collapsible under vacuum
- Resistant to oils and greases
- Resists abrasion
- Resists corrosive atmospheres
- Rated to 125 psi operating pressure
- You can't buy better air hose at any price

Call or write today for literature and prices

MUNRAY PRODUCTS, INC.
12402 CROSSBURN AVE.
CLEVELAND 35, OHIO
Phone: WI 1-0680

PLASTIC EXTRUDED SHAPES, PROFILES & TUBINGS—PROTECTIVE COATINGS—PLASTISOLS, SPECIAL MILLED COMPOUNDS

Circle **81** on Time-Saver Card

NEW PRODUCTS

resistance to oils, its dimensional and chemical stability and toughness.

Specifications: Microfinished bore held to tolerances of ±.005" which

permits maximum air flow unobstructed by imperfections found in other hose. Safety factor at room temperature in excess of 13:1. Supplied in 3/16, 1/4, 5/16, and 3/8" ID sizes in 500' lengths.

Synflex Products Division
Samuel Moore & Company
Mantua, Ohio
Circle **316** on Time-Saver Card

FILTER ASSEMBLIES . . . for high-pressure fluids

Designation: Series 2900

Features: Has pressure differential indicator with optional low temperature lockout. Two sizes can be equipped with optional temperature lockout device preventing indicator function below range of 20-35 F.

Specifications: Has female AN port sizes of 6, 8, and 12. Poro-

mesh pleated metallic elements withstand differential pressure of 3500 without collapse over range of ±350 F. Aluminum housings for operating pressures from 1000-5000; burst pressure at 12,000 psi at 100 F, 7500 psi at 300 F, and 4500 psi at 400 F.

Bendix Filter Division
Bendix Aviation Corp.
Madison Hts., Mich.
Circle **317** on Time-Saver Card

THREAD SEALANT RIBBON . . . of 100% Teflon

Designation: #26

Features: Seals by molding itself to all threaded pipes. Unaffected by acids, gases, organic solvents. For use as anti-seize and anti-galling material. Does not dry out, keeps for life.

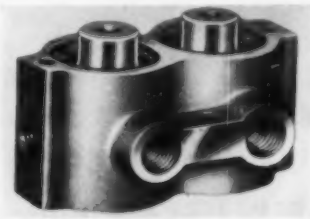
Specifications: Withstands pressures to 10,000 psi. Temperature range −450 to +500 F. Coefficient of friction measures 0.04. Affected only by molten sodium, fluorine gas, and gaseous chlorine trifluoride.

Fluoro-Plastics, Inc.
Philadelphia, Pa.
Circle **318** on Time-Saver Card

PILOT-OPERATED VALVES . . . have large capacity

Designation: FX

Features: Compactness with large capacity. Ports full-rated size throughout. Offers fast retraction, positive shut-off. Is pilot-operated. Pilot medium separated from valved



medium. Packings, pistons, metal-to-metal contacts eliminated.

Specifications: For air pressures to 125 psi. Diaphragms cycle from full open to dead seal shut-off up to 30,000 per hour. In 2-, 3-way sizes of 1/8, 1/4 and 1/2"; 4-way, 5-port 1/4" model for double-acting cylinder control. Pilot line connectors all 1/8" NPT. Bodies are machined solid steel, cadium-plated high tensile iron or cast brass. NO or NC. For temperatures −65 to 225 F.

Humphrey Products
Division of General Gas Light Co.
Kalamazoo, Mich.
Circle **319** on Time-Saver Card

DUPLEX PUMP CONTROLS . . . for twin pump application

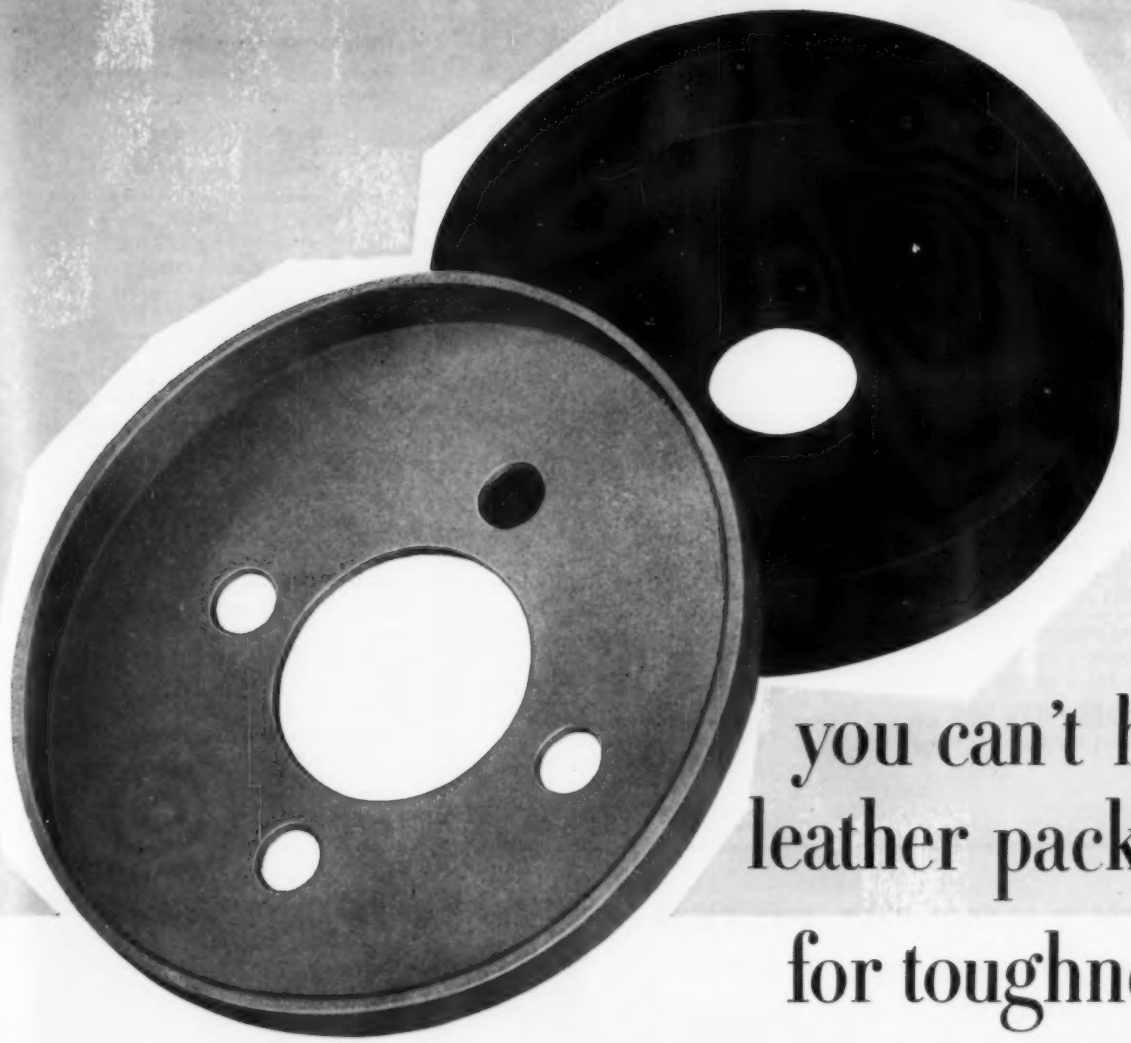
Designation: Type "DP"

Features: For installations where two pumps operate individually or together. Provides disconnect

Continued on page 118

Circle **49** ➡

MORE OF THE GARLOCK 2,000



you can't beat leather packings for toughness

Being of steerhide, they have a natural toughness and tensile strength unmatched by other materials. Also, leather packings have a low coefficient of friction, minimum cold flow. They provide extremely good resistance to abrasion and wear . . . actually tend to polish metal surfaces which they contact!

In Bitan* (Retan), chrome, or oak leather, Garlock can furnish a complete line of specially-impregnated "U" and "V" packings, molded cups, discs, washers, gaskets, flange or hat packings. Sizes range from 1/8" O.D. leather washers for needle valves to 99" O.D. packings for heavy-duty hydraulic service.

Discover for yourself the advantages of leather packings. Talk them over with your local Garlock representative. He can recommend from the famous Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. Call him, or write for Leather Packing Folder AD-121.

*Registered Trademark

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Canadian Division: The Garlock Packing Co. of Canada Ltd.

Plastics Division: United States Gasket Company

Circle **86** on Time-Saver Card

PUMPS

that offer a new approach to your design problems

BUILT-IN DIRECTIONAL CONTROL

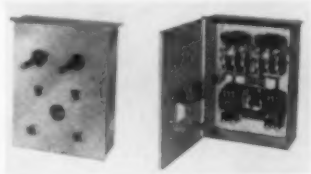
Miniaturized in everything but power, Oil-Dyne pumps provide new economy and efficiency on standard hydraulic applications . . . make hydraulic actuation possible on applications never before feasible.

Oil-Dyne pumps simplify your design problems by eliminating external directional control valving . . . integral valving permits changing the direction of cylinder travel by simply reversing the motor. Pressures to 3,000 lbs. (5,000 lb. peaks); available with or without pressure switches and/or relief valves. Write for illustrated catalog.

PIONEERING MINIATURIZED HYDRAULIC ACTUATION
PUMPS • PRESSURE SWITCHES
CYLINDERS • VALVES • ACCESSORIES
OIL-DYNE INC.
2115C West Marquette Rd., Chicago 36, Ill

NEW PRODUCTS

means for each motor, through use of disconnect switch or thermal magnetic trip circuit breaker. Front operated mechanism mechanically interlocked for safety measure. Efficient remote control assured. Panels feature under-voltage release. Original equipment includes



electric and manual alternators; control transformers; pressure switches; three forms of selector switches, and test push buttons.

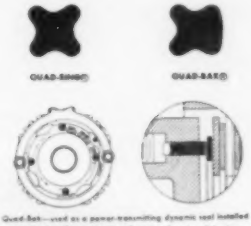
Specifications: Normally supplied with 3-pole construction for 3-wire, 2- or 3-phase power systems. Enclosures include Nema 1 and 2.

Arrow-Hart & Hegeman Electric Co.
Hartford, Conn.
Circle **320** on Time-Saver Card

SEAL DESIGN
. . . for extreme extrusion forces

Designation: Quad-Bak

Features: For special applications subject to extreme extrusion force.



Quad-Bak—used as a power-transmitting dynamic seal installed on the Auto Specialties Manufacturing Co. aircraft brake.

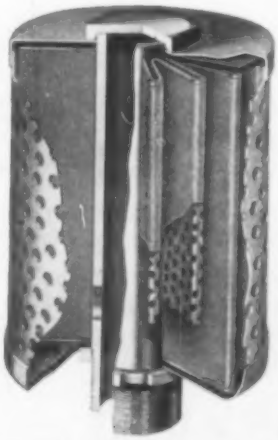
Is variation of basic Quad-Ring design, now strengthened by making one side convex, eliminating extrusion damage to lips.

Minnesota Rubber Co.
Minneapolis, Minn.
Circle **321** on Time-Saver Card

AIR CONTROL VALVES
. . . are auto-manual

Features: For automatic interlocking of manually-controlled circuits or to permit manual operation of automatically-operated system. In interlocked circuits, valve can prevent out-of-sequence or accidental

NEW SUMP OIL FILTER
for hydraulic and lube oil systems



● Screen wire mesh reinforced by pleated perforated metal provides greatly extended filtering area. This results in lower pressure drop, larger dirt capacity. Entire unit protected by perforated cover to prevent accidental damage. A wide choice of bronze, monel, or stainless media provides various degrees of positive filtration. Capacities from 1 to 100 gpm, male or female connection. Write for Specification Sheet OCO-1057. **AIR-MAZE CORPORATION**, Cleveland 28, Ohio. Dept. AH-8.

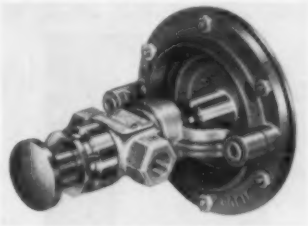
Circle **6** on Time-Saver Card

NEW!
KEPNER
Kepsel
cartridge type valve insert
The Check Valve that cuts costs of Design and Installation 75% and more!
Flexible Seal
• Leak Proof—At All Pressures
• Low Pressure Drop at Full Flow
• Eliminates All Threaded Connections
• Eliminates Expensive Machining
Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.
*Patent Applied For
Write for complete technical data
KEPNER PRODUCTS COMPANY
7321 West 59th Street
Summit, Illinois

Circle **67** on Time-Saver Card

manual actuation. In normally-automatic circuits, valve permits manual operation for machine set-up. Fitted with return spring, valve functions automatically, actuated by any 3-way pilot valve, instrument or process control.

Specifications: Available with 2, 3, or 4-way valve bodies. Piped or open end exhausts optional on 3 and 4-way valves. Port sizes from ¼-1" NPT. Valves, suitable for 20-60 psi air actuation or 15 psi

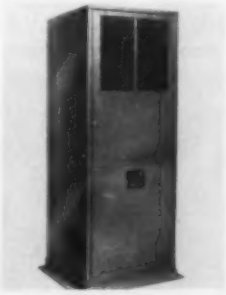


instrument pressure, handle intermittent actuation pressures to 125 psi.

Valvair Corporation
Akron, Ohio
Circle **322** *on Time-Saver Card*

COMPRESSED AIR DRYER . . . available in 3 types

Features: Deliver continuous supply of dry compressed air at moisture levels from —5 to —60 F dewpoint. Condensed water automatically and continuously ejected from unit. Arrangement of heat exchange surface directs most of



refrigeration capacity to moisture removal.

Specifications: A ¼-hp hermetic air cooled condensing unit handles 45 scfm at 100 psig from 95 F saturated to —50 F dewpoint. Measures 15x15x42".

Technical Designs, Inc.
Bedford, Ohio
Circle **323** *on Time-Saver Card*

HYDRAULIC GEAR MOTORS . . . with outputs to 25 hp

Designation: Dowty

Features: Pressure balancing and simplified design delivers overall efficiencies to 80% and contributes to longer life. Cartridge construc-

tion eliminates alignment problems because bearings position gears within one assembly, reducing working tolerances to minimum.

Specifications: Reversible motors have speed range of 300-3000 rpm. Minimum starting torque equals or exceeds 65% of running torque. Operate on fluids from SAE 10-90. In five motor sizes.

Berry Hydraulics
Division of Oliver Tyrone Corp.
Pittsburgh, Pa.
Circle **324** *on Time-Saver Card*

Continued on next page

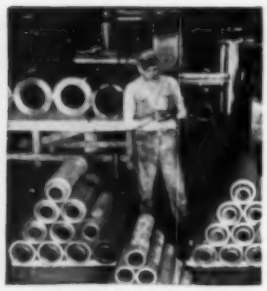
CARDWELL ELECTRIC-HYDRAULIC CONTROLS

Cardwell has specialized for many years in the interpretation of specific problems in design and execution of control panels and consoles, paying particular attention to space requirements and ease of access to components.

Do you have a problem for us to solve?

The **CARDWELL MACHINE COMPANY**
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

Circle **26** *on Time-Saver Card*



You machine better and faster with

SHENANGO CAST BAR STOCK

Because Shenango tubular stock is *centrifugally* cast, impurities and pockets are *forced* out of the metal in the molten stage. Moreover the grain is finer, pressure-dense and more uniform. This results in smoother machining, better control, and less waste of time and metal.

Made of high-strength Meehanite metal or long-lasting bronze, Shenango tubular stock comes in a *complete* range of I.D. and O.D. sizes. Its lengths go up to 20 feet, depending on diameter, which keeps cut-off waste to a minimum.

While the demand for Shenango bar stock is largely tubular . . . solid round, square, hexagonal, rectangular and other special shapes are readily available.

It will pay you to specify Shenango bar stock for longer wear, greater strength, fewer rejects . . . and lower over-all cost. For full information, write to: *The Centrifugally Cast Products Division* of The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES · ALUMINUM AND MANGANESE BRONZES
MONEL METAL · NI-RESIST · MEEHANITE METAL · ALLOY IRONS

Circle **102** *on Time-Saver Card*

NEW PRODUCTS

FILTER ELEMENT
. . . is heat resistant

Features: Made from formulated glass fused under controlled conditions of temperature and pressure. This porous ceramic element shows high resistance to heat, heat shock, and chemical attack. De-

signed primarily for micro-filtration of corrosive and high temperature liquids. Cleaned easily.

Specifications: Filters available in 1, 5, 10, 25, 50, and 100 micron particle retention ratings. Elements capable of withstanding up to 600 psig differential pressure. In three sizes: 10, 20, and 30x2½".

Commerical Filters Corp.
Melrose, Mass.
Circle **325** *on Time-Saver Card*

SOLENOID AIR VALVE
. . . can be hand controlled

Features: Can be hand-actuated whether coil is energized or de-energized. Dual function ideal for low pressure air systems to 150 psi. Manual control for applications requiring skill and judgment. Electrical and operational failures in system can be checked without halting production. Manual lever can be safety-wired to prevent actuation.

Barksdale Valves
Los Angeles, Calif.
Circle **326** *on Time-Saver Card*

Continued on page 122

Circle **41** on *Time-Saver Card*

Here's data on the *New*

DIAL HEAD AGASTAT®

time / delay / relays

These relays have recently been re-designed—improved in performance *and* appearance. So you'll want up-to-date specs.

This free folder gives complete details on all models. In it you'll find operating specs, timing ranges, contact capacities, dimensions, diagrams of contact and terminal arrangements, and data on mounting and installation accessories.

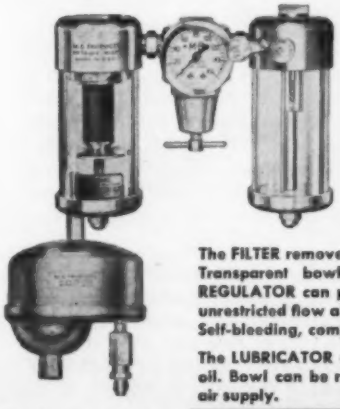
For your copy, write: Dept. A34-84

AGA ELASTIC STOP NUT CORPORATION OF AMERICA
Elizabeth, New Jersey

GREATER PROTECTION to your AIR LINE!

M·B

WHIRL-A-WAY FILTER, REGULATOR AND LUBRICATOR ASSEMBLY AND AUTOMATIC AIR TRAP (MODEL W-4)



SUCCESSFULLY USED FOR PROTECTION OF AIR VALVES CYLINDERS CONTROLS PNEUMATIC TOOLS, ETC.

The FILTER removes solids .00039 and larger. Transparent bowl provides visibility. The REGULATOR can pass large volume with an unrestricted flow and minimum pressure drop. Self-bleeding, compact.

The LUBRICATOR delivers desired volume of oil. Bowl can be refilled without shutting off air supply.

The Air Trap is automatic and eliminates manual draining.

M·B PRODUCTS
46 VICTOR AVE., Div. 10
DETROIT 3, MICHIGAN

Circle **73** on *Time-Saver Card*

REPUBLIC VALVES FOR EVERY INDUSTRY

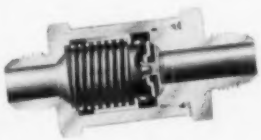
CHECKS

THAT FILL YOUR NEEDS

MINIATURE CHECKS

Mini-Valve **Regular Size Valve**

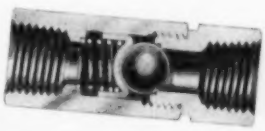
Save weight and space with Mini-Valves. They have same rated flow as regular size, but are only ¼ the size and weight. Good pressure drop characteristics. Temp. range –65° to plus 400°F. Operating pressure to 5000 psi. One-piece stainless steel body, in tube sizes 4 to 16 (¼" to 1" O.D.) Meets or exceeds requirements of MS MIL-V-25675. Port threading MS33514 flareless.



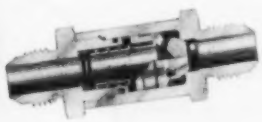
FREE-FLOW CHECKS

Extremely low pressure drop, with wide open flow. Molded elastomer seal and spherical seat prevent leakage at any pressure. Sizes ⅛" to 2" in brass and aluminum alloy up to 3000 psi, and stainless steel to 4000 psi. Opens at 2 psi. Temp. range –65° to 200°F. Pipe, internal straight thread and flared tube connections standard; MS33514 flareless available.

BALL CHECKS



Ruggedly constructed for intermittent non-shock hydraulic service up to 500 psi at temperatures –65° to 350°F. Sizes ⅛" to ¾". Brass, aluminum alloy, stainless steel. Pipe and flared tube connections.



HY-PRESSURE CHECKS

Built for continuous service in high velocity systems at pressures up to 5000 psi in steel and stainless steel, and 3000 psi in aluminum alloy. Low pressure drop. Metal-to-metal seal. Operating temperatures –65° to 250°F. Sizes ⅛" to 2", with pipe, internal straight thread and flared tube connections. MS33514 flareless available.

Distributors in principal cities coast to coast

RM REPUBLIC MANUFACTURING CO.

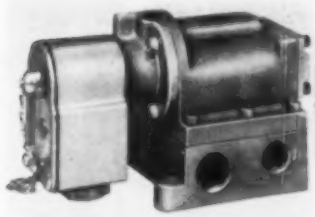
15655 BROOKPARK ROAD • CLEVELAND 35, OHIO

Circle **95** on *Time-Saver Card*

NEW PRODUCTS

AIR CONTROL VALVES
. . . for 5-200 psi service

Features: Available with variety of solenoid pilots or with pilot heads for remote operation. Solenoids may be converted from internal to external pilot supply in the field without extra parts. Short-stroke, positive-sealing poppets fully cushioned to prevent impact damage. Light weight, compact.



Specifications: For 5-200 psi service. Available in 2-, 3-, and 4-way valves. Also 4-way, 5-port. Cast aluminum bodies. Inline and subbase mounted styles.

Hoffman-Odom Co.
Dayton, Ohio
Circle **327** *on Time-Saver Card*

PISTON PUMP
. . . is compact

Features: Mounts in any position. Has direct, belt, gear, or special drives. Unloading valve has hydraulic or solenoid actuation. Uses small volume for both low, high pressure; dual volume for dual pressure. Built-in charging gear pump.

Specifications: Gear section offers ½ gpm at 1800 rpm, up to 8 gpm for other work. Piston section has capacities from 10-50 cipm at pressures to 4000. Size small, weighs under 6 lb. Motor standard AC or DC. Standard reservoir of 1 qt. to 3 gals.

John S. Barnes Corp.
Rockford, Ill.
Circle **328** *on Time-Saver Card*

AIR FILTERS
. . . have paper elements

Designation: AF-300 Series

Features: Replaceable paper elements are resin-impregnated, preformed and accordian-pleated. Application on hydraulic oil reservoirs, compressors, portable power units. Dry-type filter is only 3x4¾". Fibrous wrap around ID of element prevents oil blowback from saturating filter medium, increasing filter life.

Specifications: Handles flows to 15 cfpm, removes particles down to 10 microns. Two models available, differing in size and style of outlet connection. AF-300-7 offers 1½" straight throat, and AF-300-8 has ½"-14 NPT external thread.

Purolator Products, Inc.
Rahway, N. J.
Circle **329** *on Time-Saver Card*

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

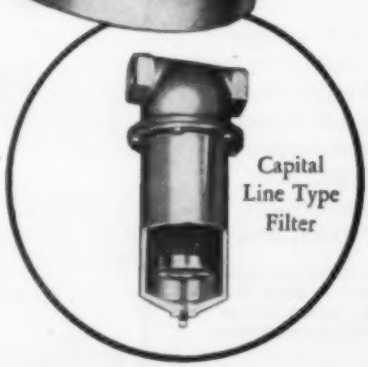
Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- **MONO-BILT 60 Mesh All Stainless Steel (Sump type).**
- **MONO-BILT Standard All Stainless Steel**
- **MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.**
- **LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.**



Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

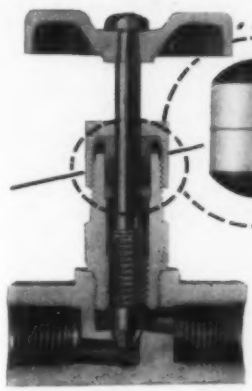
5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **25** *on Time-Saver Card*

Circle **75** on Time-Saver Card

"...yet we have **IMPROVED** *it"*

The Marsh Stainless Steel Needle Valve could have gone right on being the finest in its field...yet we have improved it



...with fabulous **"TEFLON"** *packing*

Note the "close-up." The Marsh Marpak packing system, originated in the Marsh Needle Valve, was one of the factors that has enabled it to stand up and work right under pressures up to 10,000 psi.

Now "Teflon" is used in this packing system—the miracle material of almost incredible *toughness, resilience* and *non-adhesive* properties...properties that are not impaired by the most powerful of solvents, acids, or alkalies even at temperatures *up to 500° F.*

Net result: The guaranteed application-range (up to 10,000 psi) is now effective at any temperature up to 500° F. (In other makes, permissible temperature decreases as pressure increases.)

Marsh Marpak Teflon Packing System is standard in Marsh 416 Stainless Steel Needle Throttling Valves. Ask for facts.

MARSH

Needle Valve in 416

stainless steel throughout

Now with "Teflon" Packing

MARSH INSTRUMENT COMPANY, *Division of Colorado Oil and Gas Corporation* Dept. 19, Skokie, Ill. • Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St. Edmonton, Alberta • Houston Branch Plant: 1121 Rothwell St., Dept. 19, Houston, Texas

STAFFA

HIGH TORQUE SLOW SPEED HYDRAULIC MOTOR

The STAFFA 30 h.p., 50 r.p.m., hydraulic motor operates at a working pressure of 1,500 p.s.i. with an overall efficiency of 93 per cent. Suitable for drives for CONVEYORS, WINCHES, HOISTS, CRANES, CAPSTANS and all MECHANICAL HANDLING Applications.

Ask for details of hydraulic cylinders, valves, pumps and motors.

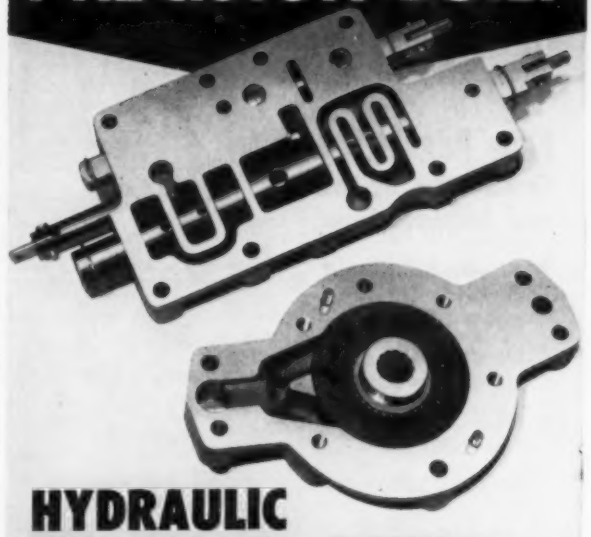
CHAMBERLAIN INDUSTRIES LTD

Staffa Works, Staffa Rd., Leyton, London, E.10, England. Leytonstone 3678

(Member of the Chamberlain Group of Companies)

Circle **27** on Time-Saver Card

PRECISION-BUILT



HYDRAULIC VALVES AND PUMPS..

to YOUR specifications

Over twenty years of specialized hydraulic valve and pump experience — newly enlarged, modernly equipped manufacturing facilities — an outstanding staff of thoroughly experienced craftsmen and an imposing list of satisfied customers is the best recommendation we can think of that you too will like our work.

Hydraulic valve and pump building is a highly specialized field demanding skills and equipment which many important companies have found too costly to maintain in their own plants. We are doing their work today.

Why not invest a few minutes to hear the advantages of our service. It might well save you money and headaches.

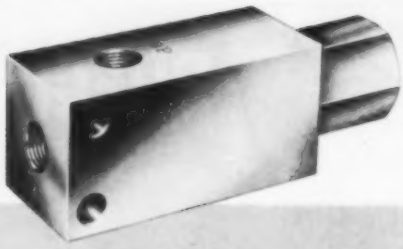
HYDRAULIC ACCESSORIES CO.

24301 Hoover Road, Warren Mich.

Circle **59** on Time-Saver Card

Circle **45** on Time-Saver Card

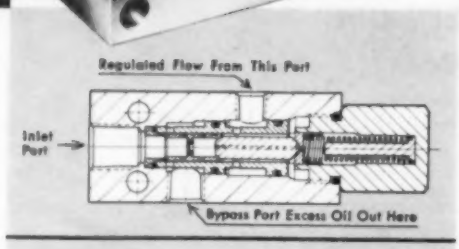
Provides Constant Flow When Loads Vary

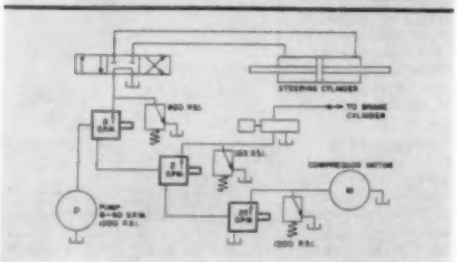


Flow Regulator
Combination By-Pass and Restrictor Type

- **Allows Additional circuits with one pump**
- **Eliminates heat — saves power**
- Sizes — ¼, ⅜ & ½" Pipe (NPTF)
- For oil to 3000 psi

Write for detailed Literature



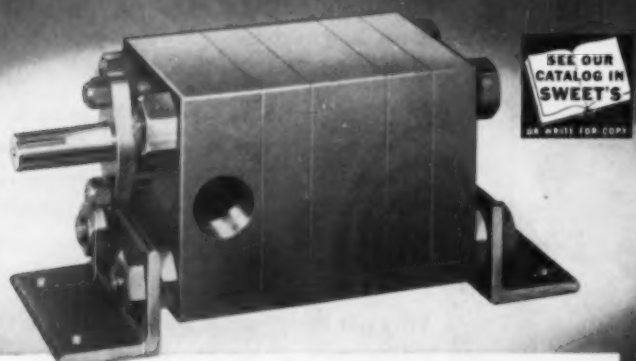


Fluid Controls, inc.
Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

NORTHERN NITRALLOY PUMPS
Lube oil, seal oil and fuel oil pumps for compressors and engines



Complete range in pump sizes from ¼ GPM to 146 GPM. Pressures to 2000 PSI. Proven in thousands of installations and backed by 50 years of engineering and production experience, Northern Steel Block Nitralloy Rotary Gear Pumps are unexcelled for precision manufacture, accurate assembly and dependable, long life operation. Write for free catalog and engineering data.

NORTHERN ORDNANCE, INCORPORATED
Subsidiary
NORTHERN PUMP COMPANY
MINNEAPOLIS 21, MINN.

Circle **84** on Time-Saver Card

USEFUL LITERATURE

Continued from page 60

CHECK VALVE INSERT

Provides leak-proof protection at all pressures, eliminates all threaded connections and expensive machining. This cartridge type insert has flexible seal seat. Product photo, diagrams, specifications, dimensions given. Graph plots flow vs. pressure drop. *Kepner Products Co., Summit, Ill.*

Circle **410** on Time-Saver Card

CASE STUDIES

Of four linear and rotary drive problems contained in four-page newsletter. Application photos and diagrams show how application engineers solved each case. News #9. *The Oilgear Co., Milwaukee.*

Circle **411** on Time-Saver Card

JIC Standards Are Ready

Copies of the revised JIC Hydraulic Standards, printed in the July issue of APPLIED HYDRAULICS & PNEUMATICS, are now available.

Single copy .....75¢
10 to 24 copies ..60¢ each
25 to 49 copies ..50¢ each
50 or more copies 40¢ each

Send your order to APPLIED HYDRAULICS & PNEUMATICS Magazine, 812 Huron Road, Cleveland 15, Ohio.

WELDED PIPE FITTINGS

Provide strong, trouble-free joints for air brake piping. Drop forging of steel provides maximum resistance to shock, vibration. Application diagrams, size tables, dimension drawings, product photos included. Bulletin RR-1. *Watson-Stillman Fittings Division, H. K. Porter Co., Inc., Roselle, N.J.*

Circle **412** on Time-Saver Card

FLEXIBLE SHAFT COUPLINGS

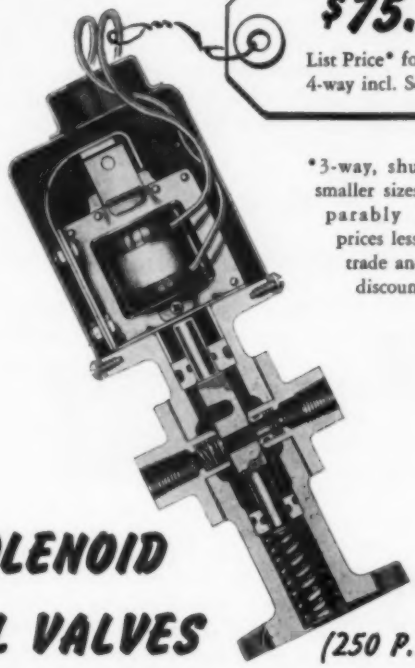
Made of light-weight Magnaloy, a magnesium alloy, in Series A with solid hub, Series B with interchangeable hub. Exploded views of both types shown in 4-page booklet. Specifications shown in charts on back page, with dimensioned drawings. *Detroit Power Coupling Co., Detroit.*

Circle **413** on Time-Saver Card

Continued on page 126

LEAKPROOF (SHEAR SEAL)

$75.00
List Price* for a ½" 4-way incl. Solenoid



*3-way, shut-off and smaller sizes are comparably less. All prices less the usual trade and quantity discounts.

SOLENOID OIL VALVES (250 P.S.I.)

WHERE	WHY	HOW
Thread rolling machines	Holding position (leakproof)	Lapped sealing surfaces seal tight indefinitely as a result of wear compensation
Pressure testing in automotive production	Oil gets contaminated by scale in castings (not critical to dirt) reduced maintenance	Sealing surfaces in constant, intimate contact, dirt can't lock valving members – saves coil burn-out
Hydraulic work feed apparatus	(Leakproof) ... as versus spool valves which cause overdemand on hydraulic system	Positive shut off of internal port to port leakage and of course, no external leakage
Machine tool chucking & clamping	Maintaining safe holding pressure (leakproof)	Saving auxiliary equipment such as pilot operated check valves
Automatic door openers	Quick action (high flow capacity)	No spools or poppets obstructing full, round flow passages
Solenoid controlled hydraulic system on machine you build	Better performance Lower manufacturing costs Reduce service problems	Shear-Seal valves have full flow, are leakproof, not sensitive to dirt Low priced, less auxiliary equipment and labor cost. Valves don't stick, saving coil burn-out; stay leakproof indefinitely, seals are wear compensating

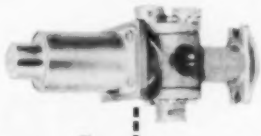
CONTROL VALVE DIVISION
Barksdale valves
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **17** on Time-Saver Card

BLAMING COIL BURN-OUT ON THE SOLENOID? THEN TAKE A CLOSER LOOK AT THE **VALVE!**

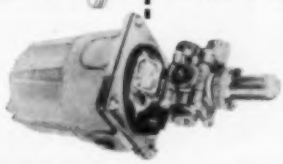
SPOOL and POPPET Valves bind and stick as dirt collects... overload solenoid and cause coil burn-out.

"SHEAR SEAL" Valves are not sensitive to dirt... always retain solenoid power margin.



D.C. SOLENOID "SHEAR SEAL" VALVES 0 to 10,000 P. S. I.

A.C. SOLENOID "SHEAR SEAL" VALVES 0 to 10,000 P. S. I.



EXPLOSION PROOF A.C. and D.C.

SOLENOID "SHEAR SEAL" VALVES 0 TO 10,000 P. S. I.

SPOOLS and POPPETS leak... can't compensate for normal wear.

"SHEAR SEAL" Valves stay leakproof... a spring takes up the normal wear.

ASK FOR CATALOG V-59-60

CONTROL VALVE DIVISION
Barksdale valves
5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **18** on Time-Saver Card

USEFUL LITERATURE

CHECK VALVES

In hard- and soft-seat models. Product photos, dimensioned charts, specifications for both models. Application photos, ordering instructions. Bulletin HAO2. *Sealol Corp., Providence, R. I.*

Circle **414** on Time-Saver Card

HYDRAULIC PUMP

Is two-stage, dual-volume, and dual-pressure. Weighs only 45 lb. Delivers from 600 cu. in. of oil/min. at 100 psi to 50 cu. in. at 10,000 psi. Illustrated and described in Bulletin V-1. *Precision Hydraulics Division, Owatonna Tool Co., Owatonna, Minn.*

Circle **415** on Time-Saver Card

LONG STROKE SEALS

Comprehensive manual for engineer, designer on long stroke, deep convolution constant area seals. Contains applications, installation drawings, attachment methods, installation techniques, standard dimensions. Detailed analysis on four basic seal classes. Tolerance tables included. Special section on practical applications. Bulletin BF200-3, 20 pages. *Bellofram Corp., Burlington, Mass.*

Circle **416** on Time-Saver Card

DESIGN MANUAL

Describes complete line of standard clamps, line supports, brackets, and shims in wide variety of shapes and sizes. Many installation techniques for all types

of hydraulic problems. Standard extreme high and low temperature insulating materials, chemical resistance data given. Weight charts, 400 illustrations. Fully-illustrated index for quick reference, pre-printed sketch sheets. No. TA210G, 94 pages. *TA Mfg. Corp., Los Angeles.*

Circle **417** on Time-Saver Card

TORQUE ACTUATOR

Incorporates full cushioning to provide 0-370° of high torque rotation. Powered by oil. Actuator seals tight. Unaffected by tension, shock, vibration, or complete power failure. Delivers controlled torque from near 0 to 15,000 in. lb. with pressures from 5-300 psi. Dimensioned drawings, size tables, torque ratings, suggested applications. Bulletin RA-500, 12 pages. *Carter Controls, Inc., Lansing, Ill.*

Circle **418** on Time-Saver Card

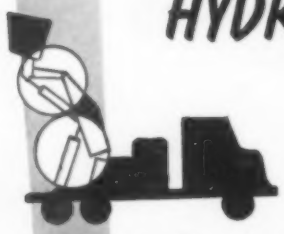
PRECISION SNAP-ACTING SWITCHES

For severe environments and mass-produced automatic devices. Dimension drawings, descriptions, force and movement specification tables, and electrical ratings for each listed switch. Data on bases, terminals, circuit arrangements and NEMA standard definitions on sensitive switch terms included. Catalog 359, 28 pages. *Unimax Switch Division, The W. L. Maxson Corp., Wallingford, Conn.*

Circle **419** on Time-Saver Card

ON THE JOB...

with CROSS HYDRAULIC CYLINDERS



Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity... quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
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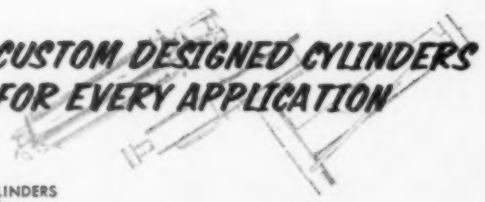
CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION



Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

HYDRAULIC CYLINDERS — CROSS MFG. CO.

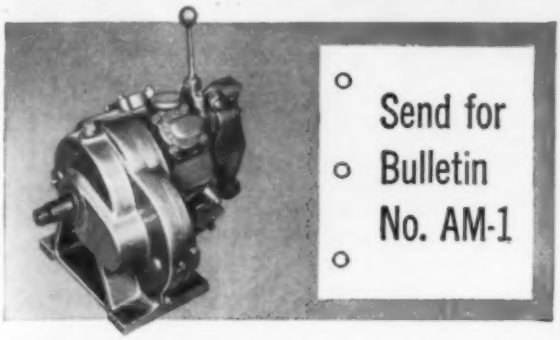
CROSS MANUFACTURING CO.
LEWIS, KANSAS – PHONE EA 4-5525

WRITE • WIRE • PHONE...TODAY!!

Circle **32** on Time-Saver Card

Circle **48** on Time-Saver Card

Here's the radial air motor for your "work horse" jobs



Send for Bulletin No. AM-1

Strong tugging action of this powerful air motor starts heavy loads easily . . . accelerates smoothly. Gardner-Denver 5-cylinder radial design means that at least two cylinders are always on power stroke. Smooth, vibrationless power is not dependent on high r.p.m. Six sizes from 2 to 16 h.p. Direct drive or built-in gear reduction. Reversible and non-reversible models.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

GARDNER-DENVER

Just Out! Just the ticket to cut cost!

NEW SPEED CONTROL VALVE

1/8" and 1/4" pipe sizes in stock now!

Now a speed control valve that regulates your cylinder movement with precision and sureness, but which lists at $3.00 and $3.25. And despite its lower costs, "CUB" features the same high quality of design and workmanship you've come to expect from Ross. "CUB'S" design stresses trouble-free operation and easy maintenance. CUB is small, aluminum and lightweight. If you use speed controls, by all means call your Ross representative or write us.

ROSS OPERATING VALVE CO.

105 E. Golden Gate Ave. • Detroit 3, Michigan

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AUTOMATIC PROTECTION!

The self-draining

WILKERSON AIR FILTER

The "AQUA-JET" completely

separates and discharges *all* harmful moisture, oil, sludge, and rust particles down to 5 microns—protects precision air equipment.

AUTOMATIC Damage, due to human failure to drain bowl, is eliminated by float operated discharge mechanism.

MINIMUM AIR LOSS Positive "snap-action" of float, soft Buna N valve seat, and large drain opening eliminates costly air loss, and possibility of mechanical failure.

FLEXIBLE USE The "Aqua-Jet" is designed for continuous or intermittent use on any type of air line operation. Full sump capacity can be expelled every 3 seconds—allows separation of large volumes if required. Available with transparent or metal bowl from 1/4" P.T. to 8" P.T., up to 635 CFM, with only 0.75-1.65 PSI pressure drop. Maximum pressure—250 PSI.

WRITE for complete specifications and information on the WILKERSON "AQUA-JET" and the name of your nearest Wilkerson distributor

WILKERSON CORPORATION THE LEADING LINE OF AIR LINE PRODUCTS

"Dedicated to keeping the NEW in pNEUmatics"

1643 West Girard Englewood, Colorado

Circle **123** on Time-Saver Card

there's **power**
to spare in
O-M heavy-duty
Hydraulic
(oil) **Cylinders**

Series TH
2000 psi operation
3000 psi non-shock
Available in 1½" to 8" bores
Meet JIC Standards

IF you need smooth, dependable straight-line motion for heavy-duty pushing, pulling, elevating, lowering, clamping or knock-out operations, these powerful, O-M components have what it takes and more, too. To deliver this plus in power, every essential design and construction feature has been employed.

For example, these units are ruggedly constructed of heavy wall seamless steel tubing microhoned to minimize friction. The ports are large and unrestricted. They can be located at 90-degree positions. These cylinders are sealed right to prevent power loss. The piston rod is stress relieved, turned, ground and polished, high tensile steel, chrome plated. In addition, the rod gland cartridge, accurately piloted in the rod head to assure perfect alignment, is easily unscrewed and removed. Pilot O.D. of cartridge serves as pilot for cylinders mounted on rod end. A cushion ball check valve provides for rapid, full power start of return stroke.

These and many other advancements are described in our latest catalog No. 105. Write for your copy TODAY or consult your local O-M representative.

ORTMAN-MILLER
MACHINE CO.
1 143rd Street, Hammond, Ind

☐ Have representative call
☐ Send Bulletin 105

Name_____ Position_____
Company_____
Address_____
City_____ Zone___ State_____

Circle **87** *on Time-Saver Card*

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

Erskine is new Racine president

John E. Erskine has been elected president of Racine Hydraulics & Machinery, Inc., Racine, Wis., succeeding his father, Malcolm E. Erskine, who will continue as chairman of the board. George B. Miller was named executive v. pres., and James E. Mohrhauser is the new v. pres. in charge of operations. The retiring president held his position 39 years. His son joined the firm in 1938 and was executive v. pres. for the last four years.

M. Erskine

J. Erskine

Mohrhauser

Miller

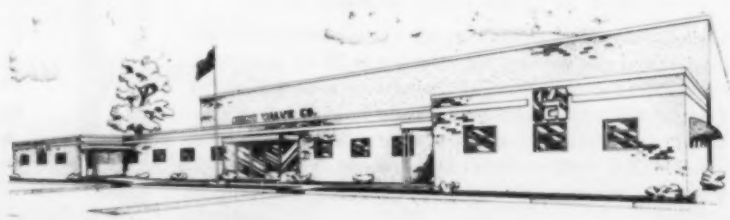
Schuette named v. pres. at Sundstrand

Louis H. Schuette has been named administrative v. pres. for all operations of Sundstrand Corp., Rockford, Ill. At the same time, A. H. Swenson was elevated from manager to v. pres. of the hydraulic division. Schuette, a company director, was v. pres. for aviation, turbo and hydraulic operations. He joined Sundstrand in 1941, was manager of the hydraulic division before becoming v. pres. in 1950. Swenson joined the company in 1935 and served as works manager of the hydraulics division and division manager before his current promotion.

Four sales changes made by Jamesbury

Enlargement of the sales activity of Jamesbury Corp., Worcester, Mass., has resulted in four staff changes. New sales coordinator is Eric W. Essen. He joined the company after six years as production control mgr. of Malleable Iron Fittings Co., Branford, Conn. Essen's assistant is Robert L. Fraser, who will act as liaison to coordinate the engineering, production, and sales activities. Newly-appointed sales representative for New England is Charles A. Richardson. He also will assist franchised dealers in developing new industrial applications. Karl Johnson is the new sales representative in the St. Louis-Kansas City area. For the last eight years, Johnson has been associated with Crane Co., St. Louis.

Continued on page 130



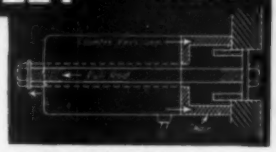
CONSTRUCTION HAS STARTED on a 12,000 sq. ft. office building in Salem, Ohio, home of Hunt Valve Co. This building is the fifth expansion in eight years for the firm, quadrupling its manufacturing area.

Circle **105** on Time-Saver Card

PULL HYDRAULICALLY AND SAVE TIME EFFORT MONEY

THE STAR CENTER HOLE RAM eliminates need for cumbersome auxiliary rigging on many otherwise tedious, time-consuming jobs. Works in congested areas — anywhere and in any direction.

Controlled by a hydraulic pump, it pulls out shafts, pistons, pinions, bushings, cylinder liners; replaces gears, wheels, propellers; tensions cables and rods for prestressed concrete. Also used as jack for lifting, pushing, or pressing.



A threaded rod inserted through center hole is shown pulling out bushing.

Capacities:
30, 60, 100, 150, 200 Tons

Special engineering counsel and proposals cheerfully submitted on request

Representative areas available.

STAR JACK CO., INC.
420 LEXINGTON AVE., Dept. AH, N.Y.C. 17
PLANT: RIVER GROVE, ILLINOIS

GRESEN HYDRAULICS

DOUBLE SELECTOR VALVE

FEATURES: Cast iron body—chrome plated, pressure balanced spool—Easy to mount —Three optional handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range—0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*
405 33th Ave. N.E., Minneapolis 18, Minn.

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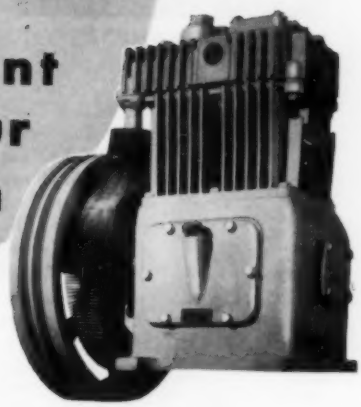
AIR POWER as efficient as your design



Quincy COMPRESSORS

With Safe-Q-Lube and Loadless Starting

Here is *versatile* efficiency.

When you specify a Quincy compressor, you select from 21 different models in a capacity range of from 1 to 90 CFM.

And Quincy gives you *long-term* efficiency. The exclusive Safe-Q-Lube system unloads the compressor in event of low oil pressure. Loadless Starting gets the unit off to smooth, easy starts.

Thus, maintenance costs and time are cut to a minimum . . . and the entire machine you design benefits from these Quincy advantages. Specify Quincy performance and durability when your plans call for an air compressor.

Industrial Models 1 to 90 CFM

Quincy COMPRESSORS

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Dept. AH-859, Quincy, Illinois

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FIRM _____

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POST SCRIPTS OF INDUSTRY

Lindner to head sales department

Lindner

Philip E. Lindner was appointed OEM sales engineer for Modernair Corp., San Leandro, Calif. Formerly a project engineer, Lindner will be in charge of the special application and OEM sales department at the home office.

3 changes made by Commercial Filters

Two promotions and an appointment were recent news at Commercial Filters Corp., Melrose, Mass. John Kirber was named manager of the New York office with headquarters in Ridgefield, N.J. He has been with the Chicago office for the last two years. Herbert A. Wilson, with Commercial for eight years, has been promoted to Eastern District Manager, headquarters at the home office. Wilson will cover the Atlantic Coast. T. C. Tiearney was appointed assistant sales manager of the Indiana Commercial Filters Corp., Lebanon, Ind.

Vickers fills new regional sales manager posts

A. L. Caney has been named as midwest regional sales manager, Mobile Hydraulics Division of Vickers Inc. He will be located in suburban Chicago. James G. Hanna fills a similar position in the West Coast region, with headquarters at El Segundo, Calif. Hanna's area covers ten states. He was district manager in Chicago and has been with Vickers since 1951.

Hanna

Caney

Grim to head Disogrin division

Kenneth H. Grim has been named as head of the Products Division, one of two new divisions created by Disogrin Industries, Inc., Mt. Vernon, N. Y. Grim's division will control all applications and sales of Disogrin products other than Disowheel, the other new unit. A graduate engineer, Grim was previously a sales engineer with the M. W. Kellogg Co. and the Combustion Engineering Co.

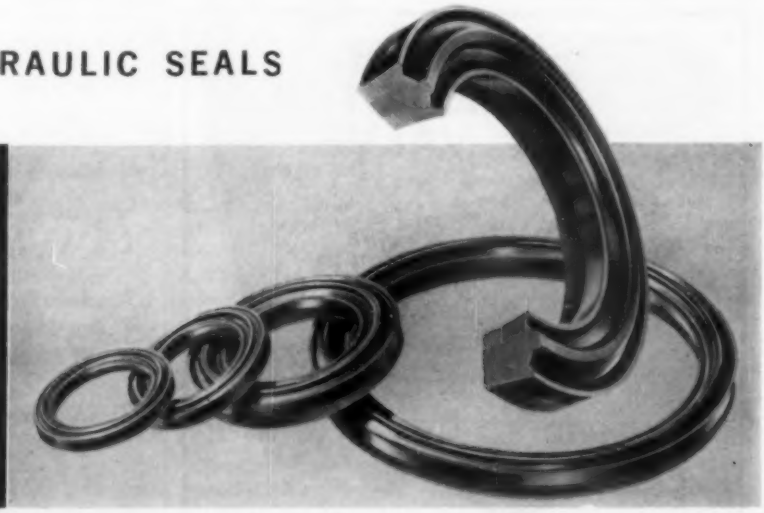
Moog establishes industrial division

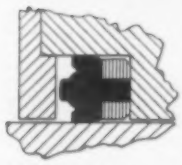
Harvard B. Kolm has been appointed manager of the newly-established industrial division of Moog Servocontrols, Inc., East Aurora, N Y. The new division will be responsible for the development of the industrial product line and all non-military product marketing activities. It also offers controls and systems engineering service. Kolm has been with Moog for two years as a staff engineer, and was responsible for developing a new servovalve.

NEW DESIGN IN HYDRAULIC SEALS

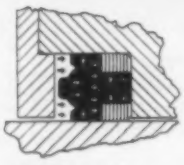
SCN-Rings

British Patent 805,253. Other Patents Pending





SCN-Ring before pressure is applied.



SCN-Ring sealing under pressure.

- Maximum sealing, minimum wear
- Saves space, reduces machining
- 50 standard sizes (3/8" to 9 1/4") in stock
- Fully resistant to hydraulic oils
- Efficient at pressure from zero to 10,000 p.s.i.
- Even distribution of pressure over the sealing surfaces
- Simple fixed depth housing
- Easy to fit

Write for Technical Brochure R28/SCN6

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(A Company of the Bell's Asbestos and Engineering Group) Telephone: Slough 25041 Telegrams: Resvalar, Slough.

Harwood named C-H v. pres.

P. B. Harwood has been appointed senior v. pres. of Cutler-Hammer Inc., Milwaukee. Formerly v. pres. in charge of engineering, Harwood plans to retire this year after 42 years of service. E. B. Fitzgerald replaces Harwood as head of engineering, having joined the company in 1946. Replacing Fitzgerald will be R. A. Haworth.

Titeflex makes changes in engineering personnel

Richard G. Walsh has been named director of engineering at Titeflex, Inc., Springfield, Mass. He came to the company from a post as department manager in the Aircraft Engine Division of the Ford

Walsh

Edwards

Motor Co. Walsh previously was with the Wright Air Development Center in Dayton, Ohio. New chief industrial engineer is Harold G. Edwards, Jr., who was an assistant to the v. pres. of operations with Veeder-Root, Inc. He is a graduate of Yale University.

Wilkerson names Koppala treasurer

Francis E. Koppala has been elected as treasurer of Wilkerson Corp., Englewood, Colo. He joined the company as a consultant on accounting matters, and still remains active in public accounting work in Denver. E. G. Schattmann has been named zone mgr. for New York and Newark for Wilkerson. He is v. pres. of Machinery and Machine Supplies Co. of New York.

Trebes appointed general manager

Trebes

Fred W. Trebes has been named general manager of the Pacific Division of Hydromatics, Inc. He was engineering group leader on control valves for Rocketdyne Division, North American Aviation, Inc. Trebes' new office will be at 7120 Remmet Ave., Canoga Park, Calif.

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SPECIFIC for Braking • Actuation • Control

WAGNER SYSTEMS applied by Experienced Application Engineers COMPLETE . . . CONVENIENTLY PACKED

Don't just guess about the parts you need . . . Look to Wagner for numerous air and hydraulic systems to supply the muscle power for: FAIL-SAFE emergency braking . . . HIGH CONTROLLED force actuations . . . REMOTE CONTROLLED system actuation. Your Wagner Systems Engineer is backed by many years of experience in braking and control system design. Call him today.

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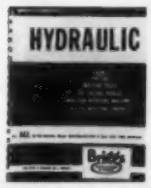
HERE is a big 8½" x 11", file size, 12 page, fully illustrated booklet. It's brimful of technical data and drawings that every designer and engineer will want to read or keep for ready reference. Write for your copy. No obligation.



Briggs — PIONEERS IN MODERN OIL FILTRATION

HYDRAULIC OIL FILTERS

PRODUCT OF BOMSER RESEARCH

THE BRIGGS FILTRATION COMPANY
DEPT. 306—WASHINGTON 16, D. C.

YES! AT NO COST or obligation, send me the above booklet.

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Company .....

Address .....

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POST SCRIPTS OF INDUSTRY

Holbrook heads division

Holbrook

Edward L. Holbrook has been appointed as head of the Eastern Division of Modernair Corp., San Leandro, Calif. Holbrook will handle civilian and government sales, and arrange for foreign licenses to manufacture and distribute Modernair products. Holbrook's promotion frees Glen R. Pittman to become general sales manager at the home office.

New officers named for F-C Institute

James R. Lawler, Jr., of the Lawler Automatic Controls, Inc., Mt. Vernon, N. Y., was elected president of the Fluid Controls Institute, Inc., in May. The institute membership consists of manufacturers of automatic regulator valves, control valves, solenoid valves, space heating specialties, steam and gas traps, and steam heating pumps. Other officers elected were Fred Weldon, General Control Co., 1st v. pres.; Robert McCormick, Automatic Switch Co., 2nd v. pres.; Paul Rogers, Jr., Skinner Chuck Co., treasurer; Eric A. Bianchi, Mason Neilan, corporate secretary, and E. R. Rath of the institute, executive secretary.

Parker-Hannifin adds new distributors

Recent announcements from Parker-Hannifin Corp., Cleveland, show five new distributor appointments. They are:

Fluid Control, Division of Petroleum Engineering Service, Charlotte, N. C., for industrial tube and hose fittings and hydraulic accumulators; *Baker Engineering and Equipment Co.*, Wichita, for hydraulic accumulators; *Aero-Land Supply Co.*, Oakland, for tube-working tools and equipment; *Hercules Packing Corp.*, Buffalo, for industrial seals and fasteners, and *Krico Engineering Co.*, Detroit, for reusable hose fittings, hose and hose assembly tools.

McGee promoted at Dynex

McGee

Hugh T. McGee, formerly mobile sales manager has been promoted to head the newly-formed marketing department at Dynex, Inc., Pewaukee, Wis. In his new job, McGee will handle corporate marketing planning, sales analyses, and product planning.

Neff elected Mechanical v. pres.

Neff

James A. Neff was named v. pres.-gen. mgr. of Mechanical Air Controls, Inc., Detroit. Prior to this appointment, he spent eight years in sales and engineering at the Neff Engineering Co., Fort Wayne, and was assistant mgr. of production at Raytheon Mfg. Co.

SAVE ON NEW & SURPLUS HYDRAULICS

NEW PALLEY HYDRAULICS

Here are two of our newly developed line of double action industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel construction. SAVE!

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" — thrust ranges up to 75 TONS at 3000 PSI.

Type (B) is an internal cap type cylinder with bores of 1-1/2", 2", 2-1/2", 3", 3-1/2" and 4". Has a thrust range of 2" to 48". Delivers up to 18,850 lbs. of thrust on 1500 PSI line pressure.

A. AS LOW AS 56.75

$20.75 AND UP B

For COMPLETE LISTING of our tremendous ON-THE-SHELF stocks and prices — Send for Cat. H-59.

3000 PSI HAND PUMP

Operates up to 3000 PSI. Has a built-in return flow check valve. Inlet port ½" AN, outlet 1/4" AN. No. HP-30

Only 22.50

1500 PSI Hydraulic HAND PUMP. Displaces 0.19 GPM at 30 cycles per min. Capacity 1.5 cu. in. per cycle. No. HP-3U 6.88

NEW HEAVY DUTY SLIDING PISTON 4-WAY VALVE

Available in Open or Closed Center. 3000 PSI type available with spring return or detents. 2000 PSI type has spring return to neutral. Specify type needed. Both have built-in adjustable relief valve. Maximum flow is 10 GPM. Order either 2000 or 3000 PSI type. SAVE at our LOW PRICES!

2000 PSI type $24.50
3000 PSI type $32.75

STRATO POWER HYD. PUMP

Delivers 10 gal. per minute at 1500 RPM at 3000 PSI. Pressure is adjustable from 2800 to 3800 PSI. A variable displacement, piston type. Displaces 1.694 cubic in. per revolution. 99.50

DBL. ACTION HYD. CYLINDER

1500 PSI. Has 2" bore, 9" stroke, 7/8" shaft, 14-1/4" length. Approx. Gov't cost —$75 Cat. No. H-48U — Used 5.95

No. H-48N — NEW 7.95

NOTE: We stock the largest ON-THE-SHELF stock of Hydraulic Equip. in the World. Stocks include Hydraulic Pumps, Valves, Cylinders, Motors, Hose and fittings of all kinds. Write for Catalog section H-59 and SAVE!

Ideal for clutch or throttle control when used as a master & slave. Bore 5/8", stroke 4-1/8", shaft 7/16", length 9-5/8". Parts 1/4" tube. NEW. Cat. No. H-60 3.75

Pay by M.O. or Check. P.O.s accepted from D&B firms rated P2½ or better. 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles Whse.

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REPRINTS

The following reprints of special reports which have appeared in APPLIED HYDRAULICS & PNEUMATICS Magazine are available:

TEMPERATURE CONTROL IN HYDRAULIC SYSTEMS . . . By Allan E. Morris

A complete report on latest developments. Sixteen pages of data on heat generation, fluids and packings, heat dissipation, system design, oil coolers, immersion heaters, and automatic temperature control.

COMPONENTS FOR WATER HYDRAULICS . . . By Allan E. Morris

A special 16-page report covering the design, selection and sizing of pumps, valves, accumulators, packings and cylinders. The report covers also additives and air controls.

WHAT YOU CAN GET IN ELECTROHYDRAULIC SERVO VALVES . . . By Wayne Kinney and Phillip Weiss

A special report showing a wide variety of electrohydraulic servo valves. Includes an article of how contamination affects servo valve design.

WHAT TO LOOK FOR IN AIR VALVES . . . By Allan E. Morris

This 16-page report contains basic designs of directional control, pressure control and flow control valves. Illustrates many different designs and points to remember in selecting a specific design.

Single copies 50¢; over 50 copies, 35¢ ea.

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NOW IN PREPARATION

The complete guide to FLUID POWER APPLICATIONS

3rd Edition—
the only complete hydraulic and pneumatic reference

DESIGN DATA AND IDEAS—Section A gives you 304 pages of standards, nomographs, formulae, circuits and product designs. Complete JIC hydraulic and pneumatic standards.

INDEX TO MANUFACTURERS—Section B lists alphabetically names and addresses of more than 600 companies making products for fluid powered machines.

PRODUCTS DIRECTORY—Section C helps locate manufacturers of hydraulic, pneumatic and electrical products. Listings of advertisers appear in bold face along with the note "See Section E pages — to —."

TRADE NAMES—Section D tells you who makes a product when you only know its trade name. Bold asterisk points out advertisers in the Directory.

SPECIFICATIONS—Section E gives you manufacturers' catalog information on their products. Advertisements are arranged alphatbetically, within limitations of binding and printing. Index pages give information on sales offices and distributors for each advertiser.

LOCAL SOURCES—Section F (Yellow Pages) lists alphatbetically by state, city and company, all local sources for fluid power components.

PUBLICATION DATE: OCTOBER 29, 1959

You can reserve a copy now. **$10.00**

Compiled and Published by
Applied **Hydraulics & Pneumatics**
The Magazine of Fluid Power
812 Huron Road
Cleveland 15, Ohio

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812 Huron Road, Cleveland 15, Ohio

Please reserve .... copy(ies) of the 1960/61 edition priced at $10.00 a copy.

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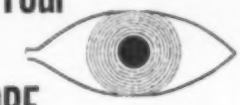

(or better yet, why not join us?)

Waldorf is the military products division of F. C. Huyck and Sons, a well known manufacturer of special engineered products for the paper industry.

We manufacture a line of fluid control devices for aircraft.

Occupying a new, fully air conditioned 65,000 square foot plant in Huntington, Long Island, Waldorf has the latest in precision manufacturing and quality control equipment.

In joining Waldorf you have the advantage of working in a small but growing organization where you will be recognized for your individual efforts, yet you have the additional advantage of having behind you the resources of a larger and rapidly growing industrial supplier with over eighty years of proven performance.

If you have the kind of experience which you feel qualifies you to become a member of our team, please write Walter S. White, Personnel Director, Waldorf Instrument Company, Huntington Station, L.I.

Candidates will be invited (expense paid) to our facility, and if the mutual decision is made that you will join us, you and your family will be relocated at our expense.

Incidentally, we are sure you will find our salary, bonus, and benefit arrangements attractive.

waldorf *fluid* SYSTEMS

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When replying to a box number in the Market Place, address your letter to Applied Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

WANTED: DESIGN ENGINEER

Design Engineer wanted, about 35 or 40, engineering degree, at least five years design experience aircraft hydraulic and pneumatic components. Compensation fully proportioned to ability, experience, imagination, and drive. Well known small company near Detroit. Please mail resume Box 8159, APPLIED HYDRAULICS & PNEUMATICS.

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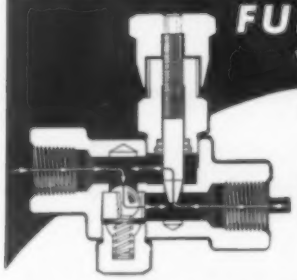

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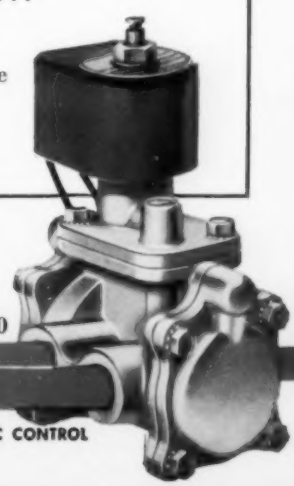

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